The Dock and Harbour Authority

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Editorial Comments

The Timber Trade of London.

The article by Mr. F. C. Bowen, appearing in this issue, on the Future Timber Business of London lends point and emphasis to the concluding paragraph of a circular emanating from the Port of London Authority, which was received too late for notice in our September issue. As the circular in question was published, or paraphrased, at the time in most of the London journals, its contents will, no doubt, be known to our readers, and it is hardly necessary, therefore, to reproduce it, at any rate in full; all that is called for here is a reference to the announcement respecting the proposed provision for the timber trade, which is made in the following terms:—

"It is expected that with the great demand for re-housing, etc., the timber trade, one of the largest dealt with in the Port before the war, will become very active as soon as the war ends and shipping space is available and conversations have taken place with the Timber Trade Federation. Adequate discharging berths will be available and storage accommodation should not become a serious problem, since it is anticipated timber in vast quantities will be required for immediate use and the trade for a considerable time will be a direct delivery one."

Whether the concluding statement implies that new and additional provision for the timber trade does not, in the Authority's opinion, fall within the class of works in the first of three successive phases of port development visualised in the circular for future action, is open to speculation, since direct delivery will not require any great amount of storage space, but, so far as we can gather from current report, a project for transferring part of the timber trade to the Tilbury Docks area has already been mooted. As regards space for expansion and amplitude of storage ground, the proposal has much to recommend it, while inland rail, road and water routes are fully available for purposes of distribution. What measures of development for the site are proposed has not yet been disclosed by the Authority, but they will be awaited with keen interest by timber importers and traders generally.

The timber trade, of course, is seasonal, and importations depend to a large extent on ice conditions in the Baltic, as also at Canadian ports on and around the St. Lawrence. With the advent of the next winter season shortly due, deliveries may be restricted by climatic conditions. Another factor which may possibly interfere with the full resumption of trade is the unknown extent to which during her occupation of the two Scandinavan countries, Germany may have depleted for her own requirements the forests of Norway and Finland.

The Levying of Port Dues.

The provision of a thoroughly logical basis on which to levy port rates and dues has been previously advocated in these columns to replace the present artificial and unsatisfactory system which has been condemned on numerous occasions by competent authorities. As far back as March, 1941, an article by Mr. E. W. Blocksidge, of Lloyd's Register of Shipping, criticised the complicated methods by which port charges are at present computed. Then, in October, 1943, Mr. A. Murray Stephen, in his presidential address to the Institution of Engineers and Shipbuilders in Scotland, dwelt on the clear necessity for a revision of the methods of ship's tonnage measurement, the regulations for which had been so frequently amended and "overlaid with compromise" that no one any longer ventured to defend them on the ground that they were fair and reasonable. The effect of anomalies on the construction of vessels was such that shipowners and shipbuilders in their efforts to obtain favourable rate levies were forced to produce ships "which in many respects were neither as efficient nor as seaworthy as they might be." Mr. Stephen suggested the adoption of a simplified formula involving only the essential data of ship's length, breadth and depth, with a single co-efficient.

In the present issue we publish a Paper by Dr. John Tutin, recently read at a joint meeting of the Institution of Naval Architects and the Institution of Engineers and Shipbuilders in Scotland in which, after reviewing the subject afresh, he follows up the suggestion of the simplified formula with the comment that, in itself, it is not a logical solution unless port costs for similar ships varied with the cube of the linear dimensions. He proposes a modified numeral additive system embodying length, breadth and depth, with co-officients for each, the co-efficients to be fixed by international agreement and "weighted" so that the three terms in the numeral have approximately equal relative importance.

Dr. Tutin adopts linear dimensions as a measure of the constructional cost of port works, though, as a matter of practical experience the cost of quay walls, dry docks, etc., is very materially affected by their depths, varying, at least, as the square

Editorial Comments—continued

of the depth and in some cases approaching the cube of the depth. This introduces a difficulty in regard to light-drafted vessels, which may be called upon to bear an undue share of the cost of deep quay walls, which they do not require, though the inequity is certainly relieved to some extent by the terms of the formula.

The problem is undoubtedly difficult and complex. It is none the less insistent and urgent, and thanks are due to those investigators who endeavour to find a solution satisfactory to all parties.

The Bombay Docks Tragedy.

The First Report of the Commission of Inquiry into the disastrous fire and explosions at the Bombay Docks on April 14th last is a grimly outspoken document. It is the painful analysis of a series of acts of carelessness and errors of judgment which led to a catastrophe involving the needless loss of, at least, 900 lives and the destruction of a vast amount of property in the city and port of Bombay, including buildings, stores and valuable foodstuffs. The pity of it is that, in the first place, the catastrophe might have been averted altogether and at a later stage, its consequences materially mitigated by the intelligent exercise of certain obvious precautions, which were not taken, or taken too late to be of any effective service.

There were a number of antecedent and contributory causes of the fire which broke out in the hold of the S.S. *Fort Stikine*, but the most probable immediate occasion, as laid down in the Report of the Commission, was " the carelessness of someone smoking in that hold." The inference is that there was also carelessness on the part of the dock officials in allowing, or not detecting it. There is a further grave reflection on the port management in the finding that " no adequate steps were taken to ensure that matches, lighters or smoking materials were not taken on board ships carrying explosives, as is done in magazine areas ashore." The *Fort Stikine* was heavily laden with explosives. Comment on this point is almost superfluous, but we cannot help alluding to the emphasis which has been laid more than once in this Journal on the vital necessity in ports of guarding with the utmost vigilance against any possible causes for outbreaks of fire. An article on this subject appeared as recently as the issue of October last, and there were others antecedently.

Limitations of space preclude detailed dissection of the Report, but readers will find the main conclusions of the Commission briefly summarised on a later page of this number. We have no wish to dwell upon the allegations of incapacity and irresolution displayed on the unfortunate occasion. It is no use " crying over spilt milk " and some of the officials implicated have paid the penalty of losing their lives. The sole relieving feature of the incident is the heroism and self-effacing efforts to stem the disaster made by those called to assist in a situation so fraught with danger to themselves.

To the Report is attached a Resolution of the Government of India dealing with, and, in certain cases, contesting the validity of the Commission's findings. One special point calls for notice. The observation is made that some of the officers referred to in the Report have perished in the disaster, while those who are living have not had an opportunity of being informed of the comments which have been made by the Commission, or of being heard in their own defence. In accordance with the principles of British justice, judgment must be withheld until the accused have had a fair and impartial hearing.

To sum up, it is a sad and painful episode, the lessons on which should be taken to heart and seriously pondered over by all port officials.

Internationalisation of Waterways.

Under war-time influence (and indeed for some time previously) there has been an outbreak of rather grandiose ideas for the combination of a number of regional traffic and transport facilities within a single administrative unit, generally national in character, to which the term nationalisation has been applied. For the moment we are not concerned with the soundness of the contentions put forward, nor with the arguments for and against nationalisation. In many respects such a policy fails to commend itself to reflective minds either as a likely panacea for the ills of the present competive system, or as an effective substitute for private enterprise. We mention it merely because it leads on and is an appropriate introduction to its later development: Internationalisation, which is entirely different in scope and character and is advocated, so far as river and canal transport is concerned, in a recently published book, entitled *International River and Canal Transport*, issued under the auspices of the Royal Institute of International Affairs.

The publication in question visualises the future administrative unification of all existing continental and regional inland waterways under an international body in substitution for the segregated national control exercised at the present time. It shows that the principle had been recognised and discussed by the Ports, Waterways and Railway Commission of the 1919 Peace Conference, though their recommendations did not mature. Subsequently, the subject was taken up at the League of Nations Commission on Communications and Transit, which submitted a draft convention to the League of Nations Conference at Barcelona in 1912, but this, too, fell through.

The only example, so far as we know, of International Waterways Control, at any rate in Europe, is the European Commission of the Danube, constituted in 1856. It was formed with the object of improving the navigable waterway for the traffic in grain and other commodities which passes through central Europe and the history of the operations undertaken for this purpose has been the subject of articles in our issues of February, 1921, March and October, 1925 and September, 1926. The technical membership of the Commission before the present war consisted of four engineers, representative respectively of Great Britain, France, Italy and Roumania.

Despite the complexity in many cases of the interests involved there are certain broad principles outlined in the publication which can be laid down for adoption in any effective scheme of international control for waterways, which include canals, as well as main rivers and their tributaries. These may be summarised as follows:

1. The maximum possible freedom of navigation for vessels of all nations without flag discrimination:
2. The obligation of riparian States to maintain all their existing facilities for transport and communications:
3. The acquiescence of these same States in the execution of improvements judged by impartial authorities to be in the general interest of international traffic, subject to the works being financed internationally:
4. The impartial regulation of traffic in the manner most conducive to economy and expedition for all parties concerned.

We imagine these principles will command general approval and subject thereto, the internationalisation of waterways is, we think, unquestionably a desirable policy. It is the logical sequel in fact, of the doctrine of the Freedom of the Seas.

Proposed Fishing Fleet Base at Wick.

Wick Harbour Trustees have decided, following visits by representatives of the Scottish Co-operative Wholesale Society, to invite that body to base a fishing fleet on Wick. This move confirms the intention of the co-operative movement in Scotland to develop its fishing activities. The Society, which co-ordinates much of the activities of the Scottish co-operative fish departments, sent representatives north to interview Mr. Manson, the chairman of the Harbour Trustees and Mr. Georgeson, the secretary. After consultation with the Trustees, the offer was made.

Wick has no local fleet of its own and this fact is regarded as an inducement to the Harbour Trustees to establish a base for the S.C.W.S. fleet. Comment that Wick had fallen from its former importance was made by Mr. James Donaldson, a leading curer, who said that the curing side lacked enterprise, initiative and foresight, which had, in the past, made Wick the leading port in the North of Scotland. He welcomed the invitation which had been extended.

The Future Timber Business of London

Impending Port Adjustments

By F. C. BOWEN.

OF all the suggestions which have been put forward for the reconstruction of the Port of London after the war, one of the most interesting is the project to collect a part of the timber trade downstream in the Tilbury area. The scheme has many factors in its favour but it must, of course, be only part of a comprehensive plan to include the whole port, brought forward by the Port Authority.

Early Enterprise

London's timber trade goes back to the very early days, when the Metropolis had consumed all the local supplies and was forced to import large quantities by coaster. A considerable proportion of this was for use as firewood, but the shipbuilding industry demanded the best and its transport from Kent and Sussex made quite a valuable business. It was not until the Eighteenth Century, by which time the demand was being satisfied from the more distant parts of the country, that home grown timber became too scarce for any but the finest ships built on the riverside and the others had to be satisfied with timber from overseas.

Long before that, timber for masts and yards had been imported from the Baltic through the Hanseatic League, and although this was interrupted when Henry VII ordered that all imported wood should be carried by English ships, the price became so high under the monopoly that an Act of 1503 restored the trading privileges to the League. By the end of the Eighteenth Century about half the oak used for shipbuilding was imported and a larger proportion of the other woods. During the Napoleonic Wars even frigates were built of Baltic fir and had an average life of only eight years; an attempt to build with Canadian fir at the end of the war had even less successful results owing to dry rot. Its trial was part of the policy of Imperial preference which caused the duty on Canadian timber to be halved in 1809, an action which had very serious results on the Baltic trade, although a certain amount of European timber was taken out to Canada and then shipped to Britain as Canadian in order to secure the lower duty.

The establishment of the chartered companies in Tudor days had a big influence on the importation of special timbers from outside Europe, in addition to the ordinary softwood by the Russian Company. In Elizabeth's day the importation of logwood was started through the capture of a Spanish ship and the sale of her cargo in London. The dyes obtained from it were so unsatisfactory that an Act was passed forbidding the use of any logwood dye and ordering that all the timber in the country should be destroyed. This Act only led to its being imported under the disguise of black wood; it was not until the reign of Charles II that the dyeing industry secured the lifting of the ban. Various other dyewoods, such as barwood from West Africa, were imported, while mahogany was brought into London in large quantities from 1724 onwards; teak from India and teakwood from West Africa, Brazil wood from Pernambuco and many other kinds were handled.

The import of Canadian timber increased steadily. In 1774 an expert was sent across by the Admiralty to report on its suitability for naval work and reported favourably on black spruce and white pine, as a result of which the British Government reserved large forest covered areas and the bulk of it entered the country through the Port of London, although some went straight to the outside dockyards. When Russia accepted the Berlin Decree in 1806, practically cutting Britain off from Baltic supplies, Canadian timber reaped the benefit but large quantities from the United States were shipped through Canadian ports. That damaged the business, as did also the inferior quality which was shipped on many occasions.

Introduction of Special Measures

The first special measures taken by the Port of London for the business were contained in the Act of 1663, which introduced the Sufferance Wharves as a relief to the Legal Quays. Timber could be discharged in the river between Westminster and Limehouse Dock, provided that the owner first paid the duty and that Customs officers were in attendance. When the dock system was improved, growing quantities were handled in enclosed water, generally with the sailing ships moored head on to quay and discharging through the big timber ports in their bows. It was sold ashore, firstly by candle auctions in various coffee houses but later very largely in the Baltic Exchange.

Before the import duties on timber were lowered an ingenious attempt was made to import it into London without paying any duty at all; in 1824 and 1825 the ships *Columbus* and *Baron Of Renfrew* were built solid in Quebec and sailed across the Atlantic to be broken up in London. The *Columbus*, 3,690 tons burthen, arrived safely but her owners tried to save the outer hull and she foundered when she was sent back for a second cargo, while the *Baron Of Renfrew* was wrecked on her maiden voyage.

The Surrey Commercial Dock System

When the Commercial Dock Company was formed in 1807 to take over the Greenland and Norway Docks of the present Surrey Commercial System, its sponsors intended to develop the Baltic

S.S. Sigurds Faulbaums (3146 tons) from Archangel — S.S. Gunny (1367 tons) from Sweden

At North Quay, Quebec Dock, Surrey Commercial Docks, 11th August, 1938

trade with special facilities for timber and in the same year the East Country Dock, South of the Greenland Dock, was started for the same purpose. The Baltic Dock Company was formed in

The Future Timber Business of London—continued

1809 to establish timber ponds in Rotherhithe, obtaining a Customs preference for bonding timber, but it was absorbed by the Commercial Dock Company before it started work. That concern soon earned an excellent reputation for the handling and safe storage of timber, with the result that it got the bulk of the Scandinavian softwood business which was inherited by the Surrey Commercial Dock Company when it was founded in 1865, by an amalgamation of the Commercial Dock Company and the Grand Surrey Docks and Canal Company. This specialisation has never been abandoned, but it has several times been suggested that a less valuable dock system might be used for timber and the Surrey Commercial handed over to other trades to whom the proximity to London was more valuable.

Although the Surrey Commercial System and its components had such an advantage there were plenty of rivals. When the City Canal, opened in 1805 to cut off the Isle of Dogs, proved a financial failure, it was sold by the Corporation to the West India Dock Company in 1829 for £120,000. It was widened into a dock

Timber Cargoes at London Docks

for the discharge of timber ships and the storing of timber and in the late 'sixties reconstructed into the present South-West India Dock. When the Millwall Dock System was started it made a big effort to capture the softwood trade from the Surrey Commercial, but was not successful and by the turn of the century it only handled about 10 per cent. of the timber imported. A proposal was put forward to spend large sums on the improvement of the timber facilities, and a start was made with the introduction of mechanical appliances for handling it, but the foundation of the Port of London Authority prevented the full scheme being carried out. The West India Dock did a big business in mahogany and large quantities of other woods for use in Thames-side industries, such as the making of barrels for cement, were discharged on to wharves.

The present Purfleet Wharf was built at the turn of last century for the purpose of importing Australian jarra wood, handled by mechanical transporters but it was afterwards turned to more general trading.

Sailing Ship Predominance

For many years timber, with its comparatively small freights, was only carried by sailing ships, their time of arrival depending on the season. The Canadian square timber business was at its height in the 'sixties of last century, after which it steadily declined with the increased demands for deals and sawn timber, a change in the business which demanded a complete change in the port facilities. For Canadian ships the business generally made the beginning and end of their career; built on speculation in various parts of British North America, they were sent across the Atlantic with a first cargo of timber to be sold to British owners and as they got older, and became water-sodden as a softwood ship did all too quickly, the timber trade was the last one in which they could be employed, generally frapped round and round with chain cable in order to keep them together. Losses were frequent and insurance premiums high, so that money had to be saved in other directions and life on board was very hard and unpopular. Many prime seamen objected to serving in a droguer, which increased the risk, and many an old sailing ship was hurriedly abandoned and, floa ing on her timber cargo, remained a menace to all other navigators for a long time.

Advent of Steamships

It was not until the mid-'seventies of last century that steamers entered the business at all, in the Scandinavian and Baltic trades to begin with, as the cost of coal prevented their being chartered for Transatlantic work. London was one of the first ports to receive them, the *Balzar Von Platen* being prominent in the early days, and they carried so much more cargo per ship, and discharged it so much more rapidly with machinery, that the dock companies were not ready for the business and it led to long delays and congestion on the quays. Even so, the steamers put on the trade were not by any means ideal for the work; like the sailing droguers, they were generally relegated to timber when they were worn out for any other trade.

The introduction of the steamers made a big difference to the Port of London because such vessels demanded specialist dock labour to replace the ship's crew for working cargo in order to avoid demurrage, and London soon collected a particularly good type of highly-skilled men.

British shipping in the trade was, however, very handicapped by our regulations with regard to deck cargo. As a result of numerous losses among British timber ships, it was forbidden altogether in 1839; when the ban was lifted in 1862, losses increased rapidly and a compromise was finally reached which limited the height of the deck cargoes in British ships while foreigners could do very much as they liked. That aspect was not satisfactory, but the foreigners brought in huge quantities and the business was very valuable. A considerable proportion of the imports were transhipped into coasters or barges, while lighters were also used for storage when the rush season made it impossible to accommodate all the timber in the yards, quays and ponds.

The War of 1914-1918 increased the demand for imported timber in the London area, but Baltic supplies were considerably curtailed even before the Revolution in Russia, and German submarines in the North Sea exacted a very heavy toll from the timber fleet. Canada was at a disadvantage owing to the length of the voyage, although the opening of the Panama Canal made a considerable difference to exports from British Columbia, the spruce of which country was particularly valued for aircraft construction.

Recent Developments

The reconstruction period after the war increased the demand for timber, just as is anticipated at the end of the present struggle. In 1920, the softwood landed in London, excluding that discharged direct into barges, amounted to rather more then 300,000 tons.

The Future Timber Business of London—continued

In 1921, the figure was over 400,000; in 1922, it was little more than 200,000, largely through political influences; but in 1923 it was again well over 400,000. Competition between the Canadian and Northern European trades was acute; for several years the Canadian supplies fell but increased rapidly under the Ottawa Agreement. London contrived to retain its position well; at the outbreak of war it was handling about one-third of the total timber imports into the British Isles from all parts of the world.

As one of the last trades of the sailing ship to Britain the " firewood trade " of short ends attracted a great deal of popular attention between the two wars and some sailing ships which had been quite famous in their day finished their careers in that business. It consisted of short ends between 18-in. and 5-ft. long, which were put aside in the saw mills and shipped at a very low freight; only a small proportion was actually used for making fires and the bulk became packing- cases, boxes and light furniture. A large part of that timber went to the Millwall and West India Docks, the character of the cargo making it impossible to handle by machinery, so that comparatively small cargoes usually took at least a fortnight to discharge and some of them considerably more. The ships employed in the firewood trade were invariably referred to as " Onkers " on the London River.

A very great part of London's success in retaining a large proportion of the trade between the two wars is undoubtedly due to the policy of the Port of London Authority in improving the facilities and meeting the modern demand of timber merchants for under-cover storage for various types of timber which were formerly always stacked in the open air. The Surrey Commercial System received particular attention; soon after the end of the last war, the Quebec Dock was constructed for the softwood trade and new sheds were erected round the Russia and Canada Docks. A very big scheme of improvement was started in 1928, by which the Lavender and Acorn Ponds were deepened, a magnificent new discharging quay was constructed and very fully equipped and the means of handling the timber mechanically were greatly improved. Other improvements were carried out before the outbreak of the present war checked their construction but not the demand for them. The very high standard of labour secured by the London Master Stevedores' Association has also had a big influence.

The Port of London has naturally suffered very greatly in the timber business during the war, but those who control its operations are determined to regain all that they have lost and athough it will undoubtedly be a very stiff fight against other ports which are equally enterprising, there would appear to be good grounds for reasonable optimism.

New Australian Graving Docks.

A new graving dock at the Port of Brisbane which was opened by the Governor of Queensland on September 18th, is of substantial dimensions, though these have not been disclosed. The dock has taken two years to construct and the cost is given at one million pounds. When Sydney Graving Dock is completed, the Brisbane dock, it is stated, will rank second in Australia. The cost has been defrayed to the extent of 50 per cent. by the Australian Commonwealth.

The South Australian Government is said to have applied to the Commonwealth Government for financial assistance towards the cost of constructing a graving dock and inner basin at the Port of Adelaide. In this case, the dock is to be 650-ft. long and the cost is estimated at £902,000.

New Graving Dock at Vera Cruz.

Completion of excavations for the construction of a dry dock on San Juan de Ulua Island, in the harbour of the Port of Vera Cruz, for the accommodation of merchant and naval vessels of up to 15,000 tons, has been announced by the Mexican Marine Ministry.

The Tower Bridge

Jubilee of a Notable Thames Gateway

The Tower Bridge, a familiar and striking structure, as well known to mariners on the " London River " as the Statue of Liberty is to navigators of the harbour of New York, attained its Jubilee on June 30th last. Fifty years previously, at 12 noon on June 30th, 1894, it was opened with full ceremony by H.R.H. the Prince of Wales (afterwards King Edward VII), acting on behalf of Her Majesty Queen Victoria.

The following account of the proceedings is taken from the August, 1944, issue of the *P.L.A. Monthly*:

It was an occasion of first importance, attended by many members of the Royal family, high officers of State and City dignitaries. The route of the procession was lined with troops from Temple Bar to Tower Bridge and the Royal Navy, the Guards, the Honourable Artillery Company and the London Rifle Brigade mounted Guards of Honour at the four corners of the bridge approaches. To emphasise the amphibious character of the new bridge the ceremony was in two parts. H.R.H. having declared the Bridge " Open for land traffic," he turned a lever controlling the hydraulic machinery and, when the leaves of the bridge had risen, declared the bridge " Open for river traffic." There followed a flourish of trumpets, the hoisting of a flag and the firing of a Royal Salute from the Tower guns. The latter was the signal for a procession of dressed ships to steam up the river, headed by the Harbour Master's vessel *Daisy*, followed by craft representing the Thames Conservancy, Trinity House, The Royal Navy, Corporation of London, merchant shipping (the General Steam Navigation Co., Ltd.) and, of course, the Watermen and Lightermen's Company. The Royal party returned from Tower Wharf in the Victoria Steam Boat Association's vessel *Palm* to the landing stage at the Palace of Westminster. Altogether a red letter day for the City of London and Father Thames of which many still living have vivid recollections.

For many years the matter of East London's cross-river traffic needs had been a " burning question " and many schemes—some fantastic—had been considered before the design of John Wolfe Barry (later Sir John) was accepted. It was stipulated that the architecture should accord with that of the Tower of London. The high level footbridges (closed these many years) are 140-ft. above Trinity high water. When the bascules are raised there is a clear waterway for ships of 200-ft. and a clear height of 140-ft. from T.H.W. In peace-time the bridge is opened for the passing of ships about 5,000 times annually, semaphore arms by day and lamp signals by night, showing in both directions, indicating the position of the bascules. A station on Cherry Garden Pier in Limehouse Reach signals the approach up-river of vessels requiring to pass through the bridge. The Tower Bridge took eight years to construct and the designer expressed the hope that it would " be considered to be not unworthy of the Corporation of the greatest city of ancient or modern times."

Startling Dock Thefts at Liverpool.

There has been disclosed in a recent police court case at Liverpool an amazing series of thefts from the Liverpool Docks, extending over a considerable period. Robert Edward McMahon, a dock labourer, was on September 20th charged with stealing 51,000 hair nets of the value of £20 and 57 yards of white silk, also valued at £20, the property of the Mersey Docks and Harbour Board.

Mr. D. E. Dalzell, prosecuting, said that a large quantity of goods was discovered at McMahon's home when the place was searched by detectives. McMahon was arrested by Detective-Sergeant Prendergast, to whom he made a statement to the effect that he and others had stolen several thousand pounds worth of property from the docks. The confession the man had made was an amazing admission of systematic stealing and receiving large quantities of goods over a period of three years. Mr. Dalzell added that considerable inquiries would have to be made in the matter and for that reason a remand was asked for.

The accused was accordingly remanded until October 5th.

Board Room with Members in Session.

Board Room of the Tyne Improvement Commission

With Members in Session

The photograph on this page is that of the Board Room of the Tyne Improvement Commissioners with the Board in Session under the Chairmanship of Sir Arthur M. Sutherland, Bt., K.B.E. The seating is arranged in the form of a double horse shoe (the outer seats being raised) facing a long table at which sit the Chairman in the centre, on a chair with the Arms of the Commission inset, and the Deputy Chairman and Chairmen of the various Standing Committees with the Chief Officials on either side.

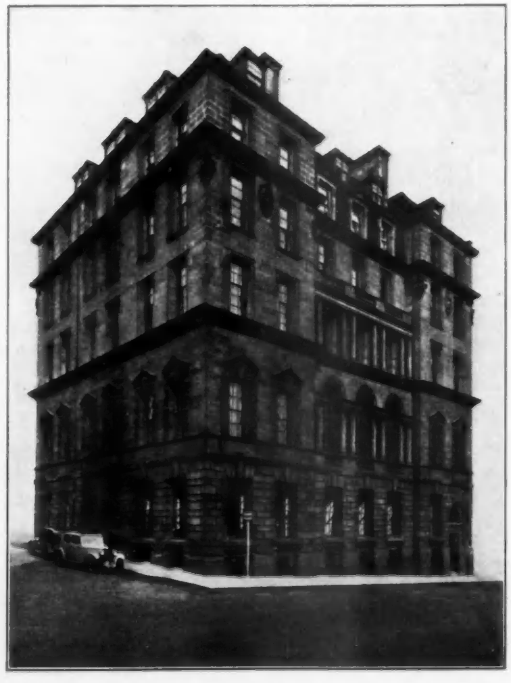
Reading from right to left and following the outer line are Messrs. Henry Armstrong (Chairman, Docks and Trade Committee), Alfred Raynes (Chairman, River Works Committee), N. M. Hood (General Manager), the Chairman of the Board (Sir Arthur M. Sutherland, Bt.), J. K. McKendrick (Secretary), Col. Sir Frank R. Simpson, Bt. (Deputy Chairman), W. A. Souter (Chairman, Finance Committee), S. E. D. Wilson, Col. T. G. Taylor (Chairman, Police Committee), J. W. Mitchell (Chairman, Piers Committee), R. H. Scott, Wm. Bramble, W. McKeag, A. V. Robinson, F. Forster, J. D. Christie, C. H. Smith, J. W. Thompson, E. F. Weidner, A. G. Everett, L. Mann and G. H. Graham. Along the inner line are Messrs. R. F. Hindmarsh (Chief Engineer), H. Tully, W. E. Stephenson, J. Mason, J. H. Ritson and T. F. Blair.

The following members were unable to be present:—Messrs. R. Irvin (Chairman, Harbour and Ferry Committee), B. G. Bryant, B. E. Common, J. Garnett, J. A. Greener, C. M. Jenkin Jones, W. Lee, A. N. Park, R. T. Smith, H. S. Streatfeild and Wm. Waugh.

In each of the two corners away from the windows are raised seats for other Officials of the Commission and members of the Press.

The room is entered through large double doors in oak. The walls are fitted with an oak dado, above which they are tinted a

(Concluded on page 137)



Head Offices of the Tyne Improvement Commission.

The Bombay Docks Disaster

Inquiry Commission's First Report

The disastrous fire and explosions which occurred at the Victoria Dock, Bombay, on April 14th, 1944, has been the subject of official enquiry by a Commission consisting of Sir Leonard Stone, O.B.E., Chief Justice of the High Court or Judicature, Bombay (President), Mr. S. B. Dhavle, I.C.S. (retired), a former Judge of the High Court of Judicature at Patna and Rear-Admiral C. S. Holland on the staff on the Commander-in-Chief, Eastern Fleet. Attached to the inquiry were five assessors and three expert advisers. The sittings were held in camera and witnesses were under oath not to disclose what took place.

The fire originated in the ss. *Fort Stikine*, a vessel taken over by the British Ministry of War Transport under the Lend-Lease arrangement. She left Birkenhead on 24th Feburary, 1944, with cargo for Karachi consisting of aeroplanes, R.A.F. and general stores, explosives and ammunition, and with cargo for Bombay consisting of 1,395 tons of explosives and ammunition and some Service stores. Reaching Karachi on March 20th, she discharged part of her cargo and reloaded with fresh cargo for Bombay, consisting mainly of cotton, but including also timber, lubricating oil, some resin and sulphur with other commodities, all authorised by the Ministry of War Transport representative at Karachi.

In this Report the Commission describe the method of taking on cargo as " haphazard." Although no protest was raised by the master or chief officer, it was brought out in evidence that the latter, who was killed in the explosion, was worried about the cotton.

The vessel arrived at Bombay on April 12th.

Suspension of Port Bye-Law

The bye-laws of the Bombay Port Trust forbade the entry into the docks of the port, of a ship carrying explosives, but under Rule 88 of the Defence of India Rules, this bye-law could be suspended in cases in which the military officer appointed for the purpose gave a certificate of grave urgency, and this certificate was given in connection with the arrival of the *Fort Stikine*. The vessel, accordingly, was berthed in dock.

The Outbreak of Fire

Discharge of explosives and ammunition was commenced about midday on April 13th. On April 14th, fire broke out in No. 2 hold where the cotton was stored. The alarm was raised at 1.50 p.m. but the outbreak may have started earlier, since no effective watch was kept on board during the refreshment hour, from 12.30 to 1.30 p.m. At first, the outbreak was not thought to be serious and there was delay in summoning the fire brigade. When the seriousness of the fire was realised, Colonel Sadler, general manager of the docks, came on board with Mr. Coombe, head of the Fire Brigade, Mr. Willson, deputy conservator of the Port Trust, Commander Longmire, R.I.N., chief salvage officer and Captain Oberst, attached to the Indian Army Ordnance Corps. These officers took divergent views as to the most advisable course of action and the master of the vessel could not make up his mind what to do.

Water admitted by the hoses into the lower hold floated some of the burning cotton upwards, thereby bringing it towards the underside of the magazines, and so increasing the heat, until at about 3.45 p.m. some of the explosives ignited. At 4.6 p.m. a terrific explosion took place and at 4.33 p.m. a second explosion. These explosions and the action taken in consequence are to be the subject of the Commissioner's Second Report, not yet issued.

The Commission's Findings

The Findings of the Commission are given in the Report at considerable length. It is only necessary to cite those of major importance, as follows:

1. The cause of the disaster is stated as being primarily due to " the existence of a state of war, resulting in the practice of bringing into dock ships laden with explosives and ammunition." The Commission agree, however, that there is no practical alternative. The reel need, they say, is for proper and adequate safety precautions.

2. In the second place, the stowage of the ss.*Fort Stikine* at Karachi was in such a way that cotton was stowed above and below explosives. A number of witnesses expressed the view that such a method of stowage was dangerous, but the master stevedore in charge of the stowage did not concur and neither the master of the ship nor the chief officer protested against loading cotton, though they did refuse to load a parcel of turpentine.

3. Then followed accidental ignition of the cotton in No. 2 hold. In the absence of any suggestion of sabotage, it is concluded that the fire was accidental and **" by far the most probable cause is the carelessness of someone smoking in that hold."** (The bold type is ours). There is evidence that although some of the oil drums were leaking, the cotton was not contaminated.

4. Next there was " failure at the outset of the fire by those present in authority to realise the gravity of the situation and failure during the course of the fire to take energetic steps to extinguish the fire or to avert the disaster by some other means. It was the duty of the master and the ship's officers to have made certain that the Fire Brigade Services were at once informed that a dangerous fire had broken out and similarly to inform the Bombay Port Trust. The master should have made an immediate request for tugs to stand by in case it was decided to move the ship out of the harbour. It is probable that had the holds been battened down and the ship taken out, the explosion would have been delayed, although this would have been a hazardous undertaking. . . . . If fire fighting was the course to be pursued, the only certain method of extinguishing the fire was to get directly at its heart with water at all costs and, if this failed, to flood the hold as quickly as possible, to use open-ended hose and every available pump. The most effective means were never employed."

5. There was " absence at the fire of a centralised executive control with power to issue paramount orders and co-ordinate the various authorites and services concerned. Colonel Sadler (the Port Trust manager) thought that the *Fort Stikine* should have been taken out of the harbour; Mr. Willson would have scuttled the ship; the master was anxious to preserve the ship, and the chief of the Fire Brigade to extinguish the fire. If there had been present at any time one man strong enough to assume command, the disaster would have been modified or even averted."

The Report also states that there was failure to inform by the regulation red flag, the other ships in the Victoria Dock that the *Fort Stikine* was laden with explosives; that no adequate steps were taken to ensure that matches, lighters or smoking materials were not taken on board; and that there was a lack of co-ordination between the ship's anti-sabotage guard and the civilian watchmen in the ship, " resulting in a haphazard and insufficient watch being kept when the hatches were open."

Indian Government Resolution

The Resolution of the Government of India appended to the Report is also a lengthy document, dealing with " the precautions and remedial action considered by the Commission to be necessary and the measures to be taken to ensure that they are adequate and are strictly enforced." It does not appear necessary to quote the resolution here, but it should be stated that it contests certain allegations and implications affecting the Government's attitude towards the carriage in ships of potentially dangerous cargo, and in regard to other matters, mainly of war-time policy.

Tribute to Deceased Officials.

At a special meeting of the Bombay Port Trust officers' Association on May 1st, homage was paid to the officers who lost their lives.

In opening the proceedings the President, Mr. L. E. Walsh, M.B.E., Deputy Manager of the Port Trust, said:—

" Sir Rama Rau and gentlemen,

" We are gathered here to-day to pay tribute to the memory of all those who lost their lives in the recent fire, including three very gallant Port Trust officers. I refer to Lt.-Col. J. R. Sadler, Mr. J. S. Nicholson and Mr. C. O. A. Martinsz, all three of whom were very popular members of this Association, and all three of

The Bombay Docks Disaster—continued

whom are missing since the day of that terrible disaster which occurred on the 14th April last. These three officers, in the face of grave danger, stood resolutely at their posts and heroically played their part in the efforts that were being made to put out the fire which eventually caused such havoc in the docks. Their self-sacrificing devotion to duty has won our admiration and will not be easily forgotten by us.

" Lt.-Col. Sadler's services were placed at the disposal of the Trustees by the Army Authorities about a year-and-a-half ago. My close association with him from the date of his appointment as General Manager has placed me in a position to be able to tell you that behind the drive and energy with which he prosecuted the war effort, he had a sympathetic heart and was ever mindful of the well being of those who served under him. In him we have lost a worthy Chief, and the Port a very efficient and capable officer.

" Mr. Nicholson was a man of charming personality. He was very popular not only with his colleagues in the Service but also with the general public in shipping circles. His popularity resulted in his unanimous election as President of the Bombay Port Trust Officers' Association for the year 1941. When as Second Officer at sea he enlisted in the British Army and went through four years of active service as an artilleryman in the last War. The urge of the sea was however in his bones and he returned to his vocation as a sailor as soon as the War was over, eventually joining the Deputy Conservator's Department as a Junior Pilot in the year 1924. At the time of the disaster he held the post of Dock Master.

" Mr. Martinsz, generally known to most of us as " Oscar " was the type of officer who did his work assiduously and conscientiously, regardless of any recognition or praise for his efforts. Of a religious disposition, he never uttered an unkind word and was held in high esteem by all with whom he came in contact. The sterling qualities innate in him are exemplified in the last act of his life. Of him it can truly be said that he was ' God's good man.' "

The following resolution was passed by the members, all standing:—

" That this meeting of the Officers of the Bombay Port Trust records its deep sense of sorrow at the loss of those who fell in the heroic discharge of their duty as a result of the catastrophe which befell the Port and City of Bombay on Friday, 14th April, 1944, and expresses its profound sympathy to the relatives of those killed or missing and those injured."

Smith's Dock Company, Ltd.

The following changes are announced to take place on January 1st next in the management of Smith's Dock Company, Ltd.:— Mr. William Reed retires from the position of general manager at South Bank-on-Tees, and is appointed naval architect to the company, retaining his seat on the board of directors. Mr. James Patton, dock manager at North Shields, is appointed general manager at South Bank. Mr. T. E. Shaw will become dock manager at North Shields in place of Mr Patton. Mr. K. H. Beale is appointed dock manager at South Bank in place of the late Mr. A. Graham.

The " Doyen " of Cardiff Docks.

Mr. Charles Frederick Mitchell, of Cardiff, active as managing director of Mitchell's General Bond, Ltd., West Dock, celebrated his 92nd birthday on September 13th. Unchallenged doyen of the Cardiff docks, where he started 76 years ago, he attends at his office every day.

The Royal Arch at Dundee Harbour.

The Royal Arch, familiar Dundee landmark and gateway to the harbour premises, is now a hundred years old. On September 10th, 1844, the arch, built in Norman-Gothic style, was opened to commemorate the landing of Queen Victoria who disembarked from the Royal yacht at Dundee harbour and proceeded by coach to Blair Atholl to spend a holiday. The arch, then made of timber, nearly 100-ft. high and decorated with the Royal Arms, bore the sign " Welcome Victoria."

Notable Port Personalities

XLV—Mr. T. Macpherson

Mr. Thomas Macpherson was appointed Regional Port Director for Scotland by the Minister of War Transport in November, 1942, in succession to Mr. Robert Letch, who was transferred to Liverpool.

Mr. Macpherson was born and educated in Glasgow, where he also received his early business training, afterwards taking up an appointment in London. He is the Chairman and Joint Managing Director of Macpherson, Train and Co., Ltd., a well-known firm of produce importers and was Chairman of the London Provision Exchange in 1941.

Mr. THOMAS MACPHERSON.

Up to the time of his appointment as Regional Port Director, he was working mainly in connection with the Ministry of Food and the Ministry of Supply. He has travelled extensively in Europe, America and the Dominions and his business activities have given him a wide experience of shipping and port problems .

Apart from his business activities, he is interested in agriculture and is a breeder of pedigree Ayrshire cattle and Clydesdale horses at his farm at Great Warley, Essex. He is also Parliamentary Labour Candidate for South East Essex.

New Ore Dock at Port Arthur.

It is announced that a contract has been placed for the construction of an ore dock at Port Arthur, Ontario. The ore will be loaded into railway wagons at the Steep Rock mine and conveyed to Port Arthur, where the wagons will discharge by gravity into the pockets of the ore pier, and from the ore pier to boats. The ore pier structure will be of reinforced concrete with 50 ore pockets on each side, each pocket having a normal capacity of 300 tons of iron ore. In order to elevate the wagons to the top of the pier structure, a long approach on a comparatively steep gradient will be built.

Developments at the Port of Gothenburg.

It is proposed to construct a deep water quay on the eastern side of the Gothaverken shipyard at Gothenburg, Sweden. The cost is estimated at 750,000 kr.

Notes of the Month

Death of Former Harbour Master.

The death occurred in August of Mr. Alexander Wood, formerly harbour master to the Anstruther Union Harbour Commission, an appointment which he resigned in May last.

Proposed Developments at Fraserburgh Harbour.

Fraserburgh Harbour Commissioners have appointed a committee of conveners and representatives of fishermen and fish curers to investigate proposals for the future development of the harbour.

Death of Dock Constructional Engineer.

There has lately occurred the death of Colonel C. W. Brims, chairman of Brims and Co., Ltd., civil engineering contractors, who have carried out important dock and quay construction and extension work on the Tyne and elsewhere.

Development of Port of Saint John.

A Committee on Reconstruction at the Port of Saint John, New Brunswick, has recommended a long term programme of harbour development to be undertaken by the Dominion Government. It proposes three projects for the first five years and two in the ensuing period. The two five year periods would involve the expenditure of 14 million dollars and provide work for 1,600 men.

Dry Dock Owners' Central Council.

At the Annual General Meeting at Edinburgh of the Dry Dock Owners' Central Council at the end of August, Mr. Hubert Thompson, a director of Vickers-Armstrongs, Ltd., was elected chairman for 1944-5. Mr. John Carson, manager of Harland and Wolff, Ltd., Liverpool, and Mr. R. H. Stephenson, a director and general manager of Smith's Dock Co., Ltd., North Shields, were elected vice-chairmen.

Proposed Separate Ministry of Fisheries.

Penzance Town Council and Newlyn Piers and Harbour Commissioners have inaugurated a movement for a separate Ministry of Fisheries, at present combined with the Ministry of Agriculture. The movement has been endorsed at Tynemouth and Sir Alexander Russell, M.P. for the borough, has been asked to give it his support.

National Dock Labour Corporation Visit to Tyne Ports.

Continuing his tour of inspection of the local organisations of the National Dock Labour Corporation, Ltd., Lord Ammon, Chairman of the Corporation, accompanied by Mr. S. C. Parkin, the General Manager, has paid a visit to the ports in the Tyne area. They were met on arrival in Newcastle by Mr. B. Elliott Common, Regional Port Director and Mr. N. M. Hood, Chairman of the local area board of the Corporation.

Defective American Port Facilities.

A survey of port facilities covering all parts of the United States, recently completed by the Army Engineers Corps, shows a surprising number of ports using facilities which date back as far as the era of sailing ships. A large majority of United States ports possess wooden piers erected at a time when steel girders as well as other modern structural materials were unheard of. To strengthen such facilities to the point at which they could accommodate modern cargoes of heavy type would mean a repair investment far beyond the means of most pier and terminal owners.

For the most part, it is pointed out, slip-ways and piers in United States ports are too narrow to accommodate the average 10,000 ton vessel which will make up the larger portion of America's post-war merchant fleet. Replacement of old wood piers and terminals with modern steel structures is necessary so that cargo handling costs can be cut down. It is the general opinion that new construction, rather than repair of existing facilities, is the only answer to America's port problem.

Bristol Pilotage Committee.

In succession to the late Alderman Hartly Hodder, Mr. K. A. L. Brown, one of the members of the City Council, has been elected to the chairmanship of the Bristol Pilotage Committee.

Death of Former Bristol Dock Master.

The death is announced of Captain William C. Johnson who for many years was in the service of the Port of Bristol Authority, first in the dredging flotilla and subsequently as dock master at Portishead. He retired in 1936.

Institute of Transport.

The date of Mr. R. Kelso's Presidential Address to the Institute of Transport at the Lecture Theatre of the Institution of Electrical Engineers, has been altered from 3rd October to 13th November, 1944, at 5.30 p.m.

Clearance of Wreckage at Bombay Harbour.

Following the disastrous explosions and fire at Bombay Docks on April 14th last, a great body of army men (5,000 in number), with over 500 military vehicles, bull-dozers and cranes have been engaged in clearing the wreckage in Bombay Docks area. Several hundred thousand tons of debris had to be removed.

Shoreham Harbour Development.

The subject of post-war improvement at Shoreham Harbour was discussed at a recent meeting of the Harbour Trustees as a result of which it was decided that the Works Committee should be instructed to consider the matter and present a report as soon as possible.

Future of the Port of Grimsby.

In commenting at an Exhibition of Corporation plans for the future of Grimsby, Mr. Henry Strauss, Parliamentary Secretary to the Ministry of Town and Country Planning, said that Grimsby must remain a great fishing port, but he wondered whether it might not also become a great port for timber from the northern countries, which was needed for re-construction purposes after the war.

Newport Harbour Board.

The Newport (Mon.) Harbour Commissioners have received, and are considering, an application from a local industrial firm for permission to discharge certain material into the river Usk, notwithstanding an Act of Parliament prohibiting the discharge of any solid matter therein. Last year it is stated that 400,000 tons of debris were dredged from the docks and 700,000 tons from the river.

Clyde Lighthouse Trust and Port Amalgamation.

At a meeting of the Clyde Lighthouse Trustees on September 6th reference was made to the appointment by the Minister of War Transport of a Commission to inquire into the question of unified control of ports in the Clyde area. It was anticipated that the Trust would be called upon to submit evidence concerning its position and activities. The Clerk to the Trustees was instructed to prepare a statement for submission to the Commission.

Official Numbering of Liverpool Docks.

The Liverpool Port Emergency Committee in conjunction with the Mersey Docks and Harbour Board and the Liverpool and Bootle Corporations are putting into operation a simplified scheme of direction notices pointing to the location of the various docks at Liverpool. Road transport drivers from the outlying districts are now to be guided by specially coloured and numbered sign-posts, erected at road junctions on the outskirts of the city, bearing the word "DOCKS." The south docks, for instance, have been numbered 1 to 23 on a green-coloured direction post; the central docks have been allocated numbers 24 to 53 painted on red sign posts and the north docks 54 to 98 on yellow sign posts.

The Fishery Port of Vigo*

A Leading Spanish Industrial Centre

By MANUEL ESPARRAGO FERNANDEZ, Engineer Director of the Vigo Harbour Works.

(Concluded from page 99)

Port Installations

Having discussed in the previous article the general lay-out of the works and the distribution of the services in the fishery port of Vigo, we now propose to complete the survey by a more detailed description of the various installations.

The already completed quays of Berbés as well as those in course of construction, i.e., the shore wall of dock No. 4, the extension of the approach route at Bouzas, the protection wall at Coya and the communication highway are of the more or less normal type and present no feature worthy of especial mention.

The only detail we shall specify is that on the highway there is no intention at present of constructing an approach route, as it is not necessary and as a few barges of no great value suffice for the needs of the factories. This permits of a substantial saving in the working costs, and the roadway may, when necessity arises, be extended in the manner that appears most suitable.

Fig. 5. Exchange Building.

On the protecting pier of Coya, it is possible, by making use of certain shallows, to erect without great expense or difficulty a spacious esplanade for the dumping of coal on which, besides the indispensable outfit, there will be established certain attached dependencies including dwellings for the workmen who are, at present, lodged more or less permanently in the lighters.

The most interesting feature is that which deals with the rehabilitation of the works and for this reason we shall give a brief description of these, so as to bring out the more important details.

Exchange Mart

Above the quay which separates docks 1 and 3 there has been erected a building to function as an exchange.

Under the designation " Exchange " is to be understood the basic and indispensable accommodation, such as the auction mart and offices for due supervision and administration; these, by themselves, are, however, not sufficient and they must be supplemented by additional services.

*Translation from Spanish of Article published in the *Revista de Obras Publicas* issue of February 1st, 1944.

In this building are housed also the Postal and Telegraph offices as also the Central Telephone Exchange, a Branch Bank, accommodation for the Harbour Authority, for the various Fishing Industry Companies, for the Conserving Agents, the Exporters, and, lastly, a Café-Bar.

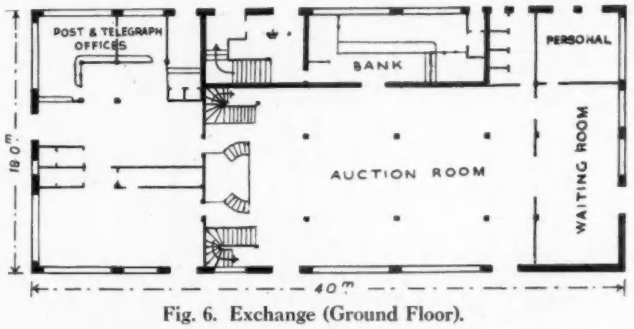


Fig. 6. Exchange (Ground Floor).

The fishery harbour, or, as it is here designated, Berbés, consists actually of a town living an intensely busy life of its own, the most outstanding characteristic of it being the postal and telegraphic activity.

It is absolutely essential for the harbour to possess its own Central Telephone Exchange and one of adequate size, as the fishery port is in constant communication with the conserving factories and with the leading centres of consumption.

In order that the sale of fish may be carried out under the most favourable conditions economically, it is advisable, and especially in the case of the deep-sea fish, to be assured of the quantity necessary to recoup their importation and the best means of ensuring this is to entrust the service to a particular Bank having a branch establishment in the harbour.

As regards the Fishery Industry Companies, the Conservers, Outfitters and Exporters, or others trading in fish whose agents are always present in the port, it is right and proper they should be encouraged by allowing them to lease a chamber where they can assemble and meet each other without neglecting their business.

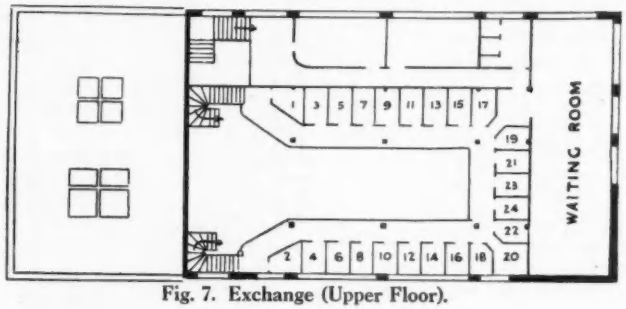


Fig. 7. Exchange (Upper Floor).

Within the fishery port live, it may be broadly stated, those connected with the sea fishery and allied industries; it is only logical to put at their disposal a saloon for coffee and a bar within a few minutes' distance from the Exchange Sales Hall, so that it can be reached as soon as an auction is announced and where they can rest during the short period of their visit to the port.

This building measures 40 metres in length by 18 metres in width.

Fishery Port of Vigo—continued

On the ground floor where the sales are carried out by inspection of samples, there are installed a table for samples, a dais and table for the auctioneer and a booth for the bidders. The construction is arranged so as to comply with the habit inveterately rooted in Vigo port, that of auctioning by lowering the price unit by unit and with the aid of an indicator ensconced to the front in the sales' hall, where there is located the dais for the official, who conducts the auctions, and with the help of a system of bells which operate sound calls in each booth and which, on actuation, arrest the needle of the indicator dial and register the number of the bidder.

Within this hall which comprises the entire elevation of the building there are housed, on the second floor and around its walls the telephone kiosks for the factory buyers who may thus easily attend to the auctioning and at the same time keep in touch with their factories.

As the activities of the Exchange are, practically, non-stop, the buyers, up till now, have been sleeping in the cabins which have been given dimensions sufficient to admit of a camp bed and also of a small table.

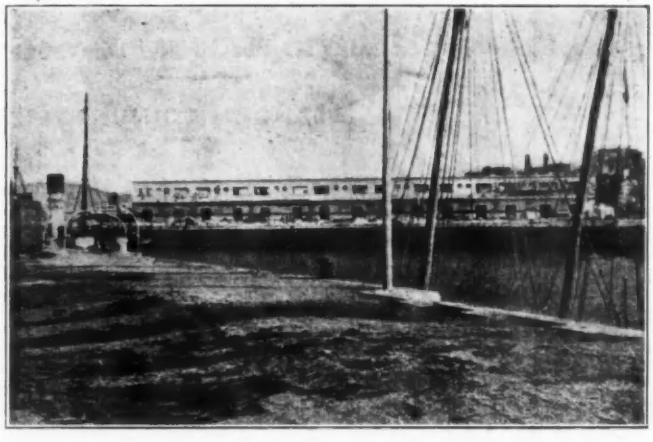


Fig. 8. Packing Shed No. 1.

On the lower floor and communicating directly with the Sales' Room is the Waiting Room as well as the Postal and Telephone Service, the Bank and the Café-Bar, all of which are of the dimensions assigned to them in Fig. 6.

On the upper floor, besides telephone kiosks, there are located with a separate entrance, the official cabin referred to above and the saloon for the directors and owners.

The departments allocated within the Sales' Hall and those allotted to the Postal, Telegraph and Telephone Services, are provided in addition to the lighting from side windows, with artificial light from the ceiling by means of chandeliers to supplement the illumination.

The sanitary installations for both public and private use have been greatly extended, these being regarded as highly essential to prevent obnoxious matter from accumulating over any length of time.

The structural material is reinforced concrete and regard has been had in the finishing off of the facades and also of the inside floorings and wall-facings, so that they shall convey an impression not of luxury exactly, but of handsome decoration.

To facilitate the cleansing operations, mainly deck-washing and flushing, except in one chamber, the paved floors are of fine hydraulic tiles and the walls present surfaces of glazed tiles.

Seeing that this building is to be erected on a quay which will not be without risk to another and older breakwater, it is preferable that when some pillars are planted on it and others on the wall of the new quay and still others on the rubber-packing of the embankment, each pillar should be cemented firmly over a firm base with the aid of fairly sized sockets, thus transferring to these the weight of the walls by means of tie girders.

Treatment Sheds

A large preliminary treatment shed has been erected in close proximity to the exchange mart and represents an accessory of first-class importance.

It measures 120 metres by 20 metres and consists of two similar spans of metal frame work covered by artificial slate.

Two other similar sheds are planned for erection along the shore wall of dock No. 1 for the reception of shell fish and the fishing harvest of the smaller craft. They will be of reinforced concrete and will exhibit the same sectional outlines as the Sales' Hall of the selling and packing pavilions.

Pavilions for Sale, Pre-treatment and Packing

The two pavilions planned will be set up along the approach way of dock No. 4, which is set aside for deep-sea fishery. It will thus occupy all the space available, seeing it is essential for fish arriving there to be sold and prepared in them.

The erection of Pavilion No. 1 is well advanced and it consists of two independent structures; the sales' hall and the building for cleansing and packing, which are separated longitudinally by a covered-in traffic corridor.

In virtue of such arrangements a considerable degree of self-containedness is maintained between the fish-selling which is public and the cleaning and pre-treatment which every participating firm carries out on its own account.

The traffic corridor referred to facilitates the removal of the fish, as soon as they are auctioned, from the sales' pavilion to the export department, an acquisition of recent times. The lading of the boxes of fish with ice for despatch inland is carried out under the roofed-in corridor into railway trucks (isothermally protected when the transport distance is great); for conveyance by road the boxes pass direct from the corridor into lorries.

The width of the sales' hall will be 10 metres which will allow of ample accommodation for the system of selling as it obtains in Vigo; the traffic corridor has a minimum clear width, at its narrowest, of 5.88 metres, which allows the lorries to pass each other.

In the case of pre-treatment departments we have endeavoured to secure the greatest possible accommodation at disposal, the external width of the building being 14.14 metres; lastly, the covered-in corridor supplying the railway has been so dimensioned that between the socles and columns there is ample room left for pedestrians to pass each other, and for a two-way stream of smaller vehicles, the columns being so distanced from the crown of the corridor with an isothermal car with its doors open will clear the gauge.

In several foreign harbours there is located above the sales' room a storey, or entresol, for the warehousing and auctioning of the boxes containing the haul of fish; in view of the local conditions here this entresol is dispensed with, as has been done also at Huelva, whereby a considerable saving is effected. The higher level is necessary in the pre-treatment departments because it is there that the empty boxes are overhauled and stored for packing, these operations requiring ample accommodation. furthermore, space is left over for the despatch and clearance work.

The sales' hall offers an unobstructed view from end to end, except that at one end the main exit is situated, the rooms above being alloted to the keepers and the auction staff. At the other end has been installed a refrigerator room for the storage of ice intended for the packing of the fish for export and also trituration, over an elevated corridor, with a moving carriage enabling the product in question to be brought to the several departments of the exporters.

This pre-treatment building is sub-divided, lengthwise, into 15 separate departments of two storeys, the clear internal dimensions of which are 13.50 metres from the basement floor, the frontage being 6.35 metres; these dimensions have been fixed on the basis of the space occupied by an exporter of average turnover in the general hall already in service, an effort being made to impart to the shops sufficient accommodation enabling those employed in them to carry on their business with comfort.

The ground floors in the pre-treatment departments are laid out in such an manner as to leave as large an area as possible free for

Fishery Port of Vigo—continued

working, even the space under the staircase leading to the upper storey where the salt is stored as also the material and equipment for sealing the cases; built into the other wall are the basins for washing the deep-sea fish and for pre-treating the sardines with brine. These basins are, of course, equipped with the requisite taps for salt water which, as we have seen, is what experience has shown to be that most suitable for cleansing the fish.

The entire floor of the pavilion exhibits a transverse gradient of 3.94: 100 which is necessitated by the abutment on the railway lines and the level of the lading quay; the gradient in question, similar to the one at Ymuiden, is steeper than the one at Lorient which is only 2.50: 100, because the floor surface at this latter port is smoother. The cleansing will be effected by rinsing shower baths of salt water for reasons of economy and a final cleansing with fresh water so as to expel any residual impurities sliding down the slippery floor.

In order to prevent any residual waste from reaching the circulation corridor through the entrances of the several departments there are installed in the corners directly opposite the ice stores, sumps with siphon taps that admit of easy cleaning; the bilge refuse from the cleansings of the corridor and the sales' hall will be expelled directly into the sea.

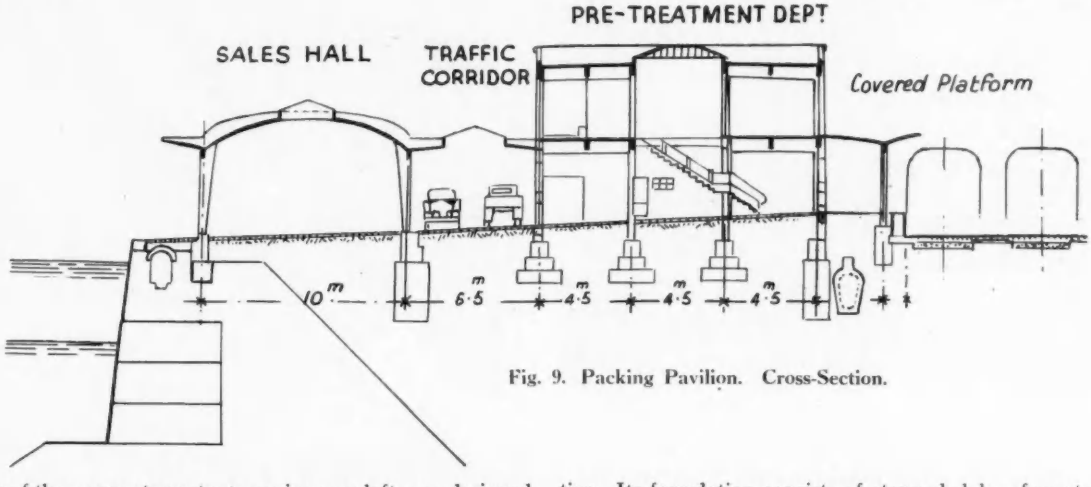


Fig. 9. Packing Pavilion. Cross-Section.

In the floor of the upper storey two openings are left, one designed for the up-take of the staircase and the other to serve as a communication for the staffs above and below and also, by the aid of an inclined plane of wood or any other material of simple make, to allow of the cases being rapidly lowered to the packing floor. These openings serve the further purpose of admitting the light entering by the windows in the flat roof and of providing by this means a satisfactory, natural illumination on the working floor.

As can be easily discerned, the entire structure of the sales' hall and the pre-treatment building has been so designed that they can be illuminated conjointly by an overhead light in the roof of the circulation corridor. This is due to the fact that subsidences in the sub-soil of the foundations have to be anticipated, primarily in the zone next to the approach pier, lying above the stone-flagged stretch running side by side, in an area starting somewhere about 20 metres from the crown, where it is permissible to suppose that precautions have been taken to render the foundations practically immovable. The massive profiles of the blocks bearing on the rather precarious stone-way are liable to experience springs and saggings which may amount, in spite of the most unscrupulous workmanship, to as much as one tenth of a centimetre and, accordingly, it has been found necessary to protect the sales' hall and to ensure solidity for the quay itself, by making use of blocks cut and chiselled as for an isostatic erection like the triple-jointed portico.

In order to obviate the sole drawback that might result from jointings based on the interplay of tie rods, namely oxidisation and ruin of these from corrosion by the medium in which they are immersed, the joints in question are raised to a level of 20 centimetres above the paved floor and the tie rods are protected on either side of the inter-section points by lead tubes of 5 mm. thickness, the joint being sealed by a layer of dense fibrous asphalt.

The floor of the section on the side of the water is made out above the jutting part of the rubble wall of the quay, at which locality, in virtue of the supporting thrust of the portico the foundation floor referred to is effectively enclosed.

The section on the land side is laid out at a level + 1 above low-water mark of equinoctial tides where there is no reason to anticipate leakages or subsidences in the breakwater, and precautions have been taken to ensure that the foundations in question are located on sites more or less immune from such subsidences. In the construction of these basic floors use is made of pipes of reinforced concrete measuring 1.60 metres in diameter and 12 centimetres in thickness, weighing 300 kg. each which are readily fitted together by taking advantage of the tides and without overscrupulously regarding any possible damage that might result from the proximity of the sea and the permeability of the soil. Once one of these pipes has been definitely positioned, it is tamped, in the usual manner, within a casing of concrete, the breakwater being finished off with " Cyclopean " concrete (of granitic consistency).

The layout and construction of the floors of this pre-treatment building are regulated so as to conform with the internal distribution. Its foundation consists of stepped slabs of mortared concrete, a binding agent that is at present indubitably to be preferred so as to obviate the wastage of iron in concrete. Only the outside foundations on the land side are constructed with caissons, similarly to what has been already indicated for those of the front portico, so as to descend somewhat below the breast-summit of the conduit already visually existent. It would be very risky to cement on the upper side since any loosening of the sand embankment by some union in the drain-system would cause a moistening of the cement.

The railway lading quay is roofed in by a simple framework of steel arches with drainage through descent pillars lined internally with a zinc tubing; this obviates the harmful gutterings due to shrinkage and trap stoppages in the down-flow.

The constructional form shows a longitudinal section with flexible joints of 3 x 6.50 = 19.50 m. each, the joints being so spaced as to minimise the effects of any slight subsidence that might set in.

The wall construction shows bases of hewn ashlar stone cemented over moulded arch-rows of mortared concrete, with the bottom of the drain-pipe forming part of the framework. The bases are designed not merely to enhance the appearance of the edifice but also to make adequate allowance for the heavy traffic that is inevitable in the neighbourhood. The remaining sections of the front elevation consist of lighter tiers of hollow blocks made from vibrated concrete with an air space and a pargeting of white cement.

In view of the dense traffic arising from wheel-barrows, motor lorries and other vehicles and the shocks that must be sustained by the paved way, the repairing of which would involve very costly interruptions in important services, the floors of the lower storey

Fishery Port of Vigo—continued

are constructed of a compound paving material with concrete as basic substance, the cost of which is not exorbitant in this district, in comparison with any other resting on a foundation of vibrated concrete with an indurated surface. On the upper storey the paving of the warehouses will consist of a simple fine dressing of mortar over the reinforced concrete girders.

The roofings of the sales' hall, the promenade corridor and of the railway platform will be rendered moisture-proof by means of several layers of a bituminous impermeable agent. The flat roof of the pre-treatment building for which a special degree of impermeability is indispensable will be equipped with longitudinal gradients of powdered concrete and above this surface will be an impermeable bituminous coating within a sackcloth backing above which again will be moulded another layer of powdered concrete so as positively to guarantee impermeability while, by way of heat insulation, the flooring will end in a fine coating of mortar, the corresponding packing joints being of fibrous bitumen-resin.

The overhead lights will have leaded frames and be of thickened, reinforced glass without putty of any kind, the sole type which, as the original equipment proved, provides an absolute guarantee and does not necessitate renewal.

The carpentry work to be adopted will be based on the principle of substantial doors and windows of chestnut wood, which is known to offer the optimum resistance to a sea environment.

The planning and erection of the pavilion have been the subject of much care and attention, the aim being to have a model for guidance in constructions to be undertaken in future. In this planning as in every effort made in the interests of the fishery harbour, very valuable and efficient assistance has been given us by our colleague D. José-Eligio Prieto Moresi.

There will be provided a complete system of basic sanitation in these installations, the diameters of all the drainage pipes being enlarged so as to avoid any obstructions that might readily arise from the enormous quantity of waste material which the foul water carries with it.

In all the sheds in which the fish have to be handled or require to stay for any length of time, the window panes will be of blue glass and the same colour will be employed in the painting of the walls and ceilings. This system has been adopted and is in vogue in other ports, as it has been observed that flies show a marked loathing for staying any time in rooms illuminated with blue light.

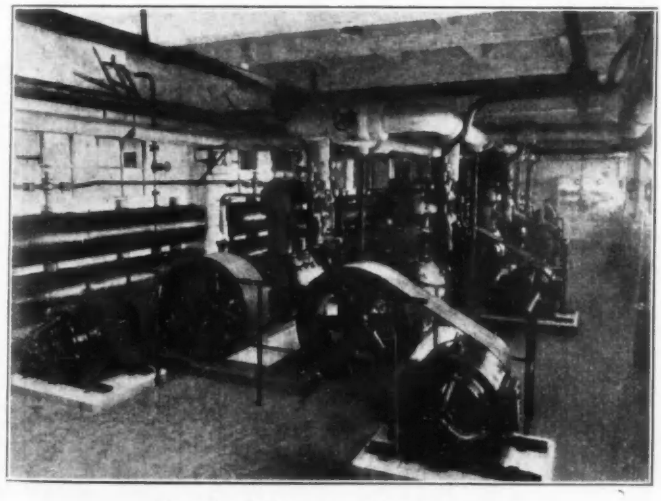


Fig. 10. Refrigerators (Engine-room).

The pavilion No. 2 will be practically similar to the foregoing except in respect of its greater length, which will be 230 metres. Also, and in conformity with this latter feature, the railway platforms will be wider.

This pavilion will comprise several packing departments of ample floor space and within it will be established the railway factory, as well as some other department, such as the Wireless Office, which will establish communication with the station that will function at some appropriate point on this estuary, for the benefit of the fishing smacks.

By the Frigorificos de Vigo, S.A., and prior to the concession by public auction, there has been erected a splendid refrigerating plant and ice factory which occupy the 2,300 square metres set apart for these purposes.

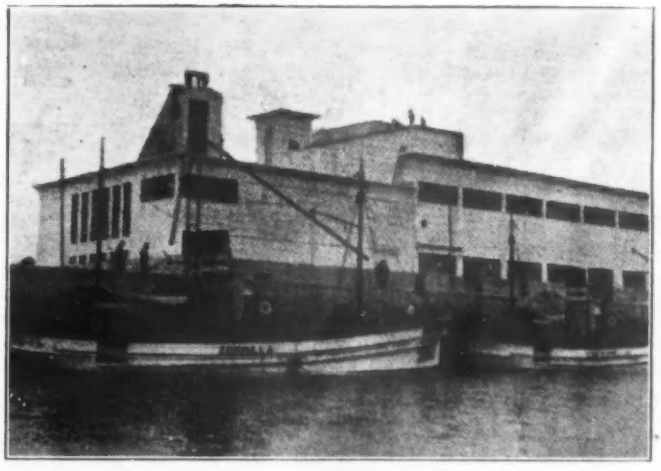


Fig. 11. Refrigerators (Service for the Manufacture and Supply of Ice).

The installations described are approaching the stage of completion in spite of the difficulties to be contended with in these times, and the service they are rendering is admirable.

The refrigerator has at its disposal such means as will ensure a rapid congelation of the fish at temperatures as low as 30 deg. below zero, while the chamber capacity will, in a short time, be as is estimated, 6,000 cubic metres.

In accordance with the stipulations of the concession, a fief duty of 5 pesetas yearly per square metre and of 1 per cent. of the gross haulage is payable to the Harbour Board of Works, the building and installation reverting to the Harbour after the expiration of forty-five years.

The ice-production may reach as high as 280,000 kg. per day, and the supply of crushed ice to the merchant fleet constitutes a priority claim, the delivery being made with the aid of two tanks each of 2,400 sub-compartments.

The purveying requirements of the fleet are provided for by a storage magazine of 1,200 tons capacity, ready to be distributed in cases of necessity.

A description of this installation in detail would require too much space, but to convey some idea of its magnitude we shall merely mention that the electric motors which energise all the services supply an energy of 800 h.p. and drive six compressors of 300,000 coolers each.

ESTIMATED COST OF THE WORKS

Specification	Pesetas	Stage of Advancement
Enlargement of the Berbes Docks	11,568,362.01	Completed
Quay of Bouzas	1,836,748.30	ditto
Communication highway between Berbes Docks and Bouzas :		
Section 1	7,994,418.04	Under construction
Section 2	1,289,382.36	Approved
Shore wall of Dock No. 4, Berbes	661,014.30	Contract withdrawn
Completion of same	3,889,061.69	Awaiting legal decision
Extension of ingress route of Bouzas	1,000,000.00	Being planned
Protection wall of Coya	4,000,000.00	ditto
Equipment (first group)	4,746,532.90	Being carried out
ditto (second group) ...	4,000,000.00	Being planned
Final outfitting	1,500,000.00	ditto
Total	42,485,519.60	

The foregoing estimates and figures are confirmed and corroborated from the detailed study made of the Fishery Port of Vigo by the Ministry of Public Works.

(Concluded on page 137)

Theory of Wave Pressures against Vertical Walls.

By "HELIOS."

HYDRODYNAMICS is a very difficult subject and the majority of hydraulic engineers are quite content to accept the general indications given by mathematicians without scrutinizing them too closely. Alternatively they may assume certain very simple hypotheses and deduce approximate rules which are controlled by experience. There are, however, cases in which these rough and ready methods are not sufficient, and it behoves the engineer to acquaint himself rather more thoroughly than usual with the fundamental mechanics of the problem. Such a case is that of the vertical wall, since it is the assumed virtue of such a wall (in sufficiently deep water) to have eliminated the action of breakers, leaving the "pure" wave reaction against the wall as the only disturbing force. As the wall is high above its base, the moment of such force is of paramount importance and a reasonably accurate estimate of its maximum amount is essential.

Over-estimation will lead to unnecessarily expensive construction and under-estimation will be dangerous.

It is therefore necessary to have a moderately good idea of three matters:—

(a) The range and length of the largest effective wave impinging square on to the wall.

(b) The laws connecting the pressure at various levels with the range and length of such wave.

(c) The duration of the impulse.

The Standard Wave

The first item in itself presents considerable difficulty, since range and length are not in constant ratio, although for medium wave lengths there is a tendency for the wave length to approximate to 15 times the range. The maximum wave length in open water after wind of prolonged duration in constant direction tends to a value of about $\frac{v^2}{8}$ where v is the mean wind velocity in feet per second. The maximum value of the range which depends on the duration of the wind, fetch and resonance with gusts is about 50-ft. but such a value only occurs with enormous "fetch" and after strong and prolonged "blows." The period of the waves is the simplest guide to wave length, being equal to $\frac{\sqrt{l}}{2.26}$ seconds where l is the length of the wave in feet, or $l = 5.15t^2$. This presupposes a depth of water not much less than the wave length. As the wave comes into shallower water, the wave length diminishes but the period remains practically the same. Hence the criterion to be observed is "the periodic time," the largest mean value for a number of successive waves of maximum strength being utilized. The range must be separately observed, not at a wall but at a pole or other meter where no reflection of importance can occur. The basic data are then the "periods" time, the computed length of the free sea wave corresponding to that time, and the free range of the wave also corresponding to that time. Let these be called t, l and h, respectively.

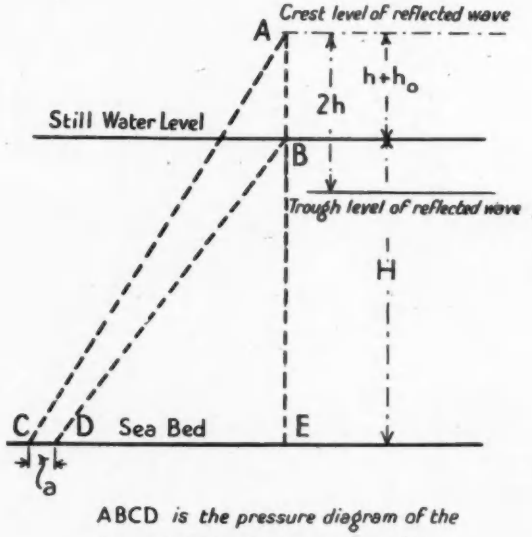
The Wall Reaction

Experience and hydrodynamic theory of uniform ideal waves show that the effect of a vertical wall is to cause an almost complete reflection of the impinging wave and the resultant of the two is a wave of twice the range and with internal movements which are practically the algebraic sum of those of the generating wave and its reversed image. This is what is called the "clapotis." Closer observation shows that the composite wave is at a higher level than the generating wave. At the wall the water rises and falls twice as much as the free wave does at an isolated measuring pole, and more than half this double range is above the still water level. In addition, the crests no longer "travel" as do those of the free wave, but appear to disappear alternately at fixed points ("antinodes") every half wave length from the wall. When the crests are highest and troughs deepest, the whole water is momentarily stationary and conversely in the intermediate moments there is great activity, the water surging up towards the forming crests, down to the forming troughs and swinging rapidly backwards and forwards at the intermediate points. This is often called a "standing wave," but the only sense in which it "stands" is that the crests and troughs occur at the same places and do not travel horizontally.

Hydrodynamic theory has a very elaborate technique for determining the pressure in the free wave, but except in relation to pressure recording in open water this does not help to deduce the pressure against the wall, unless it is assumed that the pressures are simply double those of the free wave. Owing to the lack of symmetry of the wave above and below the still water level, this can only serve as a first approximation, and proves to be appreciably incorrect for waves of significant range.

It might be supposed that the simple increase of hydrostatic head due to the rise of the surface was a sufficient indication of the pressures. Thus, if a wave of 8-ft. range is reflected, forming a 16-ft. range "clapotis" with the still-water level about 10-ft. below the crests, it might be supposed that a simple sur-pressure of $\frac{10}{3.5}$ tons per sq. ft. existed from sea level down to the bottom, dimishing to zero at the crests. If the wave is very long (and therefore slow) this is nearly true, but when the periodic time is only say 10 seconds or less, the accelerations greatly modify conditions and the motions are almost entirely at the surface. As a result the sur-pressure at the still water level is only about 2/3rds the apparent hydrostatic head and at the bottom the sur-pressure may be very small indeed.

Sainflou in the 1928 "*Annales des Ponts et Chaussées*" developed an analysis of the motions and pressures in the clapotis, from the older standard analyses (of Cauchy, Poisson, Airy, Boussinesq and Stokes) of the free wave, which appears to be as near to a complete solution as can be found. Being an engineer he reduced it to a practical form. Unfortunately, although he does give a formula for the pressure, it is not reducible to a practical simple expression in terms of the depth of any particular point and in practical computations his graphical method of representing



ABCD *is the pressure diagram of the sur-pressures due to wave reaction.*
h_0 *is the rise of the mid-wave level above the still water level.*
a *is the value of the pressure at the sea bed due to wave action.*
BED *is the ordinary still water pressure diagram*

(Concluded on page 137)

Port Rates and Dues

Methods of Levying Charges for Services to Shipping*

By JOHN TUTIN, D.Sc., M.I.N.A.
Consulting Engineer and Naval Architect, London

Synopsis

A. A review of present methods of assessing ships, and of levying dues thereon.

B. A submission that a more equitable basis of assessment would be " Rateable Length," as defined in the paper.

1. The payment of dues by ships for the use of harbours and waterways is a custom which can be traced back to the earliest records of maritime commerce. It is probable that at first dues were assessed on a linear scale using the length of hull as the basis. Later came an assessment based on the number of bales or casks (" tuns ") that the holds would carry. The convenience of this method was, no doubt, somewhat marred by its flexibility, and it led eventually to the " cubic " or quasi volume measurement of gross and net tonnage. Dues for services to ships, as distinct from services to cargoes, are largely based on these and other measurements by all maritime nations with few exceptions.

The basis used for levying a particular charge and the amount of that charge is usually determined at the discretion of the port or canal authority. Thus the statutory position is that although the measurement of a ship for tonnage is compulsory, that charges should be based on that measurement is not compulsory, except State charges, including the services of the State in making measurements. There may, however, be a statutory obligation, as in Great Britain, that charges are to be reduced if the revenue exceeds the cost of maintenace of the services and facilities provided, and in the special case of the Panama Canal, maximum and minimum dues are fixed by Act of Congress.

Present System of Levying Charges

2. In the main, the levying authorities attempt to adjust their charges so that there is a partial compromise between the value of the services provided for a particular ship and the " capacity to pay " of that ship. The universal difficulty in making net or gross tonnage serve as a satisfactory yardstick for the purpose of such a compromise is evident by the fact that amongst the various methods of assessment for various services throughout the world are found the following:—

Gross Tonnage (flat rate)
Gross Tonnage (scale rate)
Net Tonnage (flat rate)
Net Tonnage (scale rate)
" Canal " Tonnage (flat rate)
Gross Tonnage and draught
Net Tonnage and draught
Displacement
Draught
Length
Length and breadth
Flat rate per ship

In addition the charges may vary with:

Type of ship: e.g. whether cargo or passenger
State of ship: e.g. whether loaded or in ballast
Object of entering port: e.g. whether loading, discharging, repairs, refuge or bunkering.
Nature of cargo
Origin of ship and/or cargo
Destination of ship and/or cargo
Distance of pilotage
Time in port
Frequency of arrival
Number of crew
Number of passengers.

The services for which dues are levied may be broadly divided into capital and revenue charges. These and the corresponding basis of assessment are indicated in the following table:

Capital Charges	Basis of Assessment
Launching dues	Gross or Net
Fitting out dues	Gross or Net
Dry Dock dues	Gross or Net
Trial trip dues	Gross or Net
Classification fees:	
Hull survey fee	Gross
Machinery survey fee	Nominal horsepower
Classing fee	Gross
State charges:	
Tonnage measurement fee	Gross
Load line fee	Gross
Survey fees	Gross
Miscellaneous official fees including life saving appliances, light and sound signals, wireless and sundry equipment	Fees per schedule

Revenue charges	Basis of assessment
Port dues	Gross or net
Canal dues	Net (Canal Measurement)
Light dues	Net
Pilotage	Draught, draught and distance Gross or Net and distance
Towage	Gross or Net or per tug, and distance
Dry Dock	Gross
Painting	Gross
Surveys: Classification and State	Gross, and Nominal horse-power
Miscellaneous charges, including boat assistance, buoyage, berthage, hospital, quarantine, etc.	Sundry rates per port schedule

The foregoing table is not of course intended to give more than an indication of the diversity of the services rendered by the levying authorities and the diversity in the basis of levying them. Each port is a special case, far more so than the ship, and the same basis does not suit all ports or all services at the same port.

The relative importance of certain charges can be seen, in a broad way, from specimen data of actual voyages. Port and light dues, taken together, are usually larger than pilotage and towage. A single canal passage on a voyage may cost as much as several ports of call. " Sundry charges " are by no means negligible.

Allocation of Operating Costs

3. The operating costs of a port or canal authority (ultimately paid by the ships and cargoes serviced thereby) come under four main headings.

1. Charges against capital, including construction of piers, breakwater, docks, jetties, landing stages, canal excavation, locks, cranes, floating craft, warehouses, railways, roads, offices and sundry works.
2. Maintenance costs of the above.
3. Service costs, including salaries, and wages of service personnel, materials, stores, fuel and power.
4. Administration and sundries, including administrative staff, office expenses, rates and taxes.

The corresponding revenue is derived from:

1. Receipts from handling cargo and passenger traffic.
2. Receipts from shipping dues.
3. Receipts from miscellaneous sources.

Thus only a percentage of the annual port charges and port revenues are attributable to services to ships as distinct from services to cargoes. A substantial part of the cost is represented by fixed overhead charges which cannot be directly related to the dimensions of ships serviced or to facilities for handling cargoes. Other items, however, may be closely related to ship dimensions

* Paper read at Joint Meeting of the Institution of Naval Architects and the Institution of Engineers and Shipbuilders in Scotland, September, 1944.

Port Rates and Dues—continued

such as depth and breadth of dredged channels, size of docks and dock entrances, length of wharves, piers and jetties, depth and breadth of canals, length and width of locks.

The construction of a dry dock or canal lock to accommodate a certain maximum size of ship might be expected to vary roughly with the product of length, breadth and depth for excavation plus the product of length and depth for the construction of dock sides, and with the product of breadth and depth for the dock gates. The cost of a canal of a given length might be expected to vary with the product of breadth times depth, piers and wharves varying approximately with length.

For the use of wet dock facilities, an assessment based on length times beam might appear logical, if beam were an important factor, but this is rarely so, length being the governing factor for facilities alongside loading and discharging berths, and in certain ports, dues are in fact charged per foot of ship's length. Similarly other items can be, and are, rationally assessed on a linear rather than a cubic basis, as for example, pilotage dues which are almost universally based on draught.

4. A recent Presidential Address to the Institution of Engineers and Shipbuilders in Scotland, has already dealt with the well known irrational influence of tonnage rules on machinery spaces, superstructures, double bottoms and tankers.

Naval architects have on previous occasions asserted before this and other techincal institutions that ships should be assessed for dues on a numeral co-ordinating internationally recognised dimensions, namely, length (L.B.P.), breadth (mouded), and draught (summer load-line), or draught (actual), which may be taken to " Measure roughly the cost of building and maintaining the harbour or canal facilities."

It has been suggested that a suitable numeral might take the form

$$\frac{L \times B \times d}{\text{coefficient}}$$

This has the merit of extreme simplicity and gets rid of illogical allowances for machinery spaces and superstructures. Such a numeral does not, however, co-relate ship dimensions in a way which could have even a broad relation to the cost of port facilities. On the contrary, over a wide range of sizes and types of ships, it would follow fairly closely the variation in tonnage values, so that unless, in fact, port costs for similar ships vary with the cube of linear dimensions it is not a logical solution.

The levying of dues on ships on a tonnage basis has some important arithmetical consequences. In the case of, say, three geometrically similar ships with lengths in the ratio of 1: 2: 3, the tonnage and therefore the flat rate charges are in the ratio of 1: 8: 27. Thus a 400 foot ship would be assessed to pay approximately eight times as much as a 200 foot ship and a 600 foot ship approximately 27 times as much. The 600 foot ship may or may not produce 27 times as much revenue as the 200 foot ship, but it certainly does not make 27 times as great a demand on port or canal facilities, or justify such an extreme disparity in charges, even allowing for sliding scales in favour of larger vessels.

Proposed New System of Charges.

5. *It is therefore suggested that if the present system were to be replaced by a numeral system, embodying L, B, and d the terms should fundamentally, be additive.*

A suitable numeral (N) might be:

N = L × coefficient, plus B × coefficient, plus d × coefficient.

The coefficients would preferably be fixed by international agreement, and " weighted " so that the three terms in the numeral have approximately equal relative importance. In this way artificial distortion of dimensions would be discouraged.

To improve the physical significance of such a numeral it is suggested that it might take the form:

$$R = 1/3\ N$$

The numeral R would then be regarded as the " Rateable Length " and would, in fact, be a composite value combining length, breadth and draught in approximately equal proportions (for example, the coefficient, might be 1.0, 6.0, and 16.0 respectively, which would give a Rateable Length less than the actual length of ship over a wide range of vessel, the difference depending on the influence when weighted, of length, breadth and draught). Such a numeral has, in effect, a finite value at zero length of ship because the ratio of breadth to length, and draught to length increases as length diminishes.

With a numeral of the L × B × d type, keeping L constant, B and d may, for example, be reduced by, say, one per cent. each and block coefficient increased by two per cent., thereby keeping the displacement the same, yet nevertheless reducing the assessment by two per cent. On the other hand, with a numeral of the additive and weighted type, as proposed above, the corresponding change in the assessment would be less than one per cent.

For the purpose of State, classification society, and sundry official dues, including light dues, the draught factor in such a numeral would preferably be based on the summer load-line draught. For port and canal dues the mean (actual) draught should be used. If the draught on departure differs from the draught on entering, the mean of means might be used. A wide range of conditions is thus covered by a single numeral, such as a ship entering fully loaded and leaving light, or vice versa, of vessels only partially loaded. In this way a great deal of the complication involved in the use of gross and net tonnage would be dispensed with. There should be no practical difficulties in recording mean draughts for this purpose: the record can be made at the same time as the draught for pilotage dues.

Similarly, it is possible, with the aid of the same numeral, to dispense with complicated tables for pilotage; without which dues based on draught only, are quite unfair to ships of the same draught but different lengths and breadths.

6. In the House of Commons, the Parliamentary Secretary to the Ministry of War Transport was asked in February, 1944 whether, in view of the widely held opinion that existing rules for the measurement of ships' tonnage should be altered and a new and simple rule evolved, he would consider the setting up of a committee to draft proposals for international agreement. The Parliamentary Secretary replied that " Tonnage measurement rules had been the subject of recent discussion in the shipping press and a wide divergence of opinion appeared. It was plain that any change in the present rules would necessitate elaborate inquiries by shipowners and shipbuilders as well as international agreement with other maritime nations. For these reasons it would not be opportune to undertake so long and difficult a task at present. He had, however, given instructions that the matter should be considered as soon as the opportunity permitted."

Later in February, 1944, the Shipbuilding Conference passed the following Resolutions:

" 1. That the tonnage measurement laws for ships are out of date and are in urgent need of drastic revision in order to remove impediments to desirable development in new ships.

2. That the matter of revision be pressed upon the British Government for urgent discussion with the United States and other maritime nations as a necessary pre-requisite to post-war shipbuilding progress."

Moorsom's original paper on this subject—the basis of the present system—was read to this Institution, in its first year, 84 years ago, and many subsequent papers have been read and discussed. From the outset, and continuously up to the present day, members of the Institution have been critical. It is clear that before a " drastic change " can be effected, naval architects must amongst themselves, agree by majority opinion, on appropriate recommendations to the State Authorities, otherwise the State can fairly plead " wide divergence of opinion."

The author, therefore, in submitting for consideration by the Institution the concept of " Rateable Length " as a logical and equitable assessment, would loyally support any alternative or modification which might in due course be officially recommended by the Institution, and, no doubt, other members who might find themselves holding a minority view, would be agreeable to adopt the same policy, with a view to securing effective action on a major issue.

The Design of Wharves on Soft Ground*

By HORACE DENTON MORGAN, M.Sc. (Eng.), M.Inst.C.E.

Introduction

ONE of the major problems in the construction of wharves is that of designing suitable foundations for the heavy loading involved in cases where no hard stratum is found at a reasonable depth.

In many parts of the world sites for good harbours and anchorages are to be found at the mouths of large and slow-flowing rivers where the bed is often of alluvial silt, which may sometimes contain or be underlain by sand. When it is not practicable to find a hard foundation within a reasonable depth it is necessary to found on the alluvium. The solution is then a matter of distributing the load so as to keep the ground stresses within the capacity of the weak material.

Driven Piles

The most commonly used form of support for structures over water is the driven pile, the use of wnich is well known to engineers.

The oldest problem in connection with driven piles—the determination of probable bearing capacity from data obtained during driving—is still not fully solved, and probably never will be. Many formulas have been proposed for this purpose, some of an entirely empirical nature and others attempts at rational expressions. An interesting review of these has been published by Mr. A. C. Dean, M.Inst.C.E.[1]. The results given by such formulas are not of great value in soft ground. The more successful, which are based upon considerations of energy, can give with reasonable accuracy an indication of the driving resistance of the pile, but it is well known that the bearing value which a pile may develop in soft ground is usually considerably higher than its driving resistance. It may be recalled that during the construction of a wharf at Shanghai, each of a particular group of four piles sank to its full penetration under its own weight and that of the hammer, and the latter had to be held up to provent further movement. After one month, however, the group successfully carried a test load of 45 tons[1].

When carrying out works in soft ground it is necessary to drive groups of test-piles at convenient intervals throughout the whole area, carefully noting the sets obtained. The piles are then tested after a suitable period and their bearing capacity is determined. For that particular site, observations of the sets obtained during driving of subsequent piles will then furnish a guide as to their bearing capacity.

As a matter of interest, the relation between estimated driving resistance and set for a typical pile as determined by a number of formulas is shown in Fig. 1. The curves have been plotted for a timber pile 50-ft. long and 14-in. square section. It will be seen that almost any result can be obtained. It was customary with the early formulas to apply a comparatively large factor of safety to the result obtained in the case of the McAlpine formula; this was perhaps fortunate.

Probably the most successful attempt at a rational formula made in recent years is the Hiley, but unfortunately it is necessary to use a number of constants relating to the temporary compression of the pile and the ground and the efficiency of transmission of the blow from the hammer. Tables have been published giving the values of these constants which are recommended by its author. These are based on experience, but cannot apply rigidly to any individual case.

It is possible to obtain a check on the values for the temporary compression of the pile and the ground by fixing a sheet of paper on the side of the pile. A heavy straight-edge is then held horizontally by two men and used to rule a line on the paper as the hammer falls. This straight-edge is, for practical purposes, instantaneously at rest and the trace left by the pencil-line therefore gives a record of the value of the temporary compression as well as of the set taken by the pile. Attempts to include the temporary compression of the rope grummet in the helmet by the same method have not so far proved successful, as there is always some tilting of the helmet when the blow takes place. The condition of this grummet must have a pronounced effect upon the efficiency of transmission of the blow. When new it is several times thicker and much more elastic than when it has been used for a time.

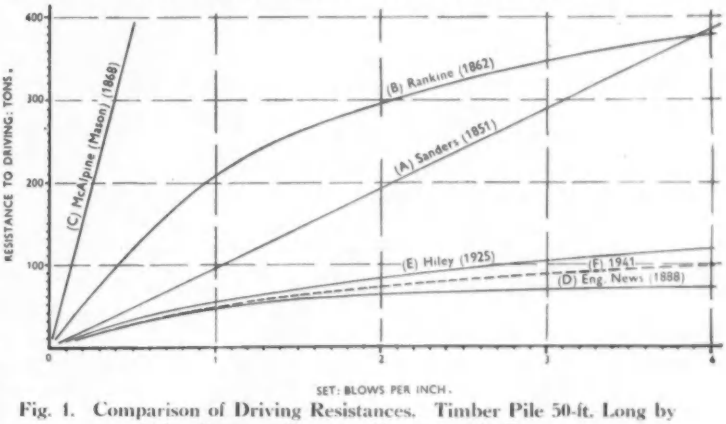


Fig. 1. Comparison of Driving Resistances. Timber Pile 50-ft. Long by 14-in. Square. Two-ton Hammer 4-ft. Drop.

As an experiment, in connection with some works then under construction, the Author prepared a set of curves relating to driving resistance and set, which may be of interest. An energy equation was used, the total energy applied to the pile being taken as some fraction of the total kinetic energy of the hammer, as in the Hiley formula. It was assumed that during the short period when the pile was taking its set it would be uniformly compressed throughout its length by a force equal to that of the driving resistance. On this assumption the strain-energy put into the pile and subsequently lost could be written down. The work done against the driving resistance in giving the pile its set was then obtained by deducting this strain-energy from the total energy applied to the pile. The assumption as to uniform compression of the pile is open to criticism. The effect is one of impact and the pile may traversed by a series of compression waves. A curve showing the relation between driving resistance and set, as determined by this method, has been included in Fig. 1 for the purpose of comparison with other formulas. The curve of relation between driving resistance and set lies between the *Engineering News-Record* and the Hiley curves. A set of curves for a typical pile using various types of hammer is given in Fig. 2.

A useful feature of such curves is that they illustrate the futility of driving beyond a certain point with a hammer of a given size. Persistent driving beyond the point simply results in waste of time and material. It is frequently apparent that this fact is not always appreciated on works. A point is reached at which the energy of the hammer is completely expended in compressing the pile and the ground, and useful driving can be obtained only by increasing this kinetic energy. In the case of steam-hammers working at their correct pressure, no increase can be obtained. With the drop-hammer more energy can be obtained by increasing the drop, but this involves higher velocity of impact, and damage to the head of the pile and loss of efficiency in the blows soon set a limit to this method. The only practical remedy is an increase in the weight of the hammer.

*Paper read before the Institution of Civil Engineers, January, 1944. Reproduced by permission.

[1] "Piles and Pile Driving."

[1] S. H. Ellis, "Reinforced-Concrete Wharves and Warehouses at Lower Pootung, Shanghai," Min.Proc.Inst.C.E., vol. clxxxviii (Session 1911-12, Part II), p. 80.

Design of Wharves on Soft Ground—continued

Composite Piles

It may be of interest to mention two cases of the use of composite piles. Piled foundations were used for the extension behind the deep-water berthage at Beira, Portuguese East Africa, in order to provide area for transit sheds. The cost of reinforced concrete was high at that time and the necessary skilled labour was difficult to obtain. On the other hand, a plentiful supply of timber for piles was available. Unfortunately timber could not be used above bed-level owing to the attacks of the *teredo*. For this reason a composite pile was used having a length of timber in the lower part and reinforced concrete above, which effected a substantial

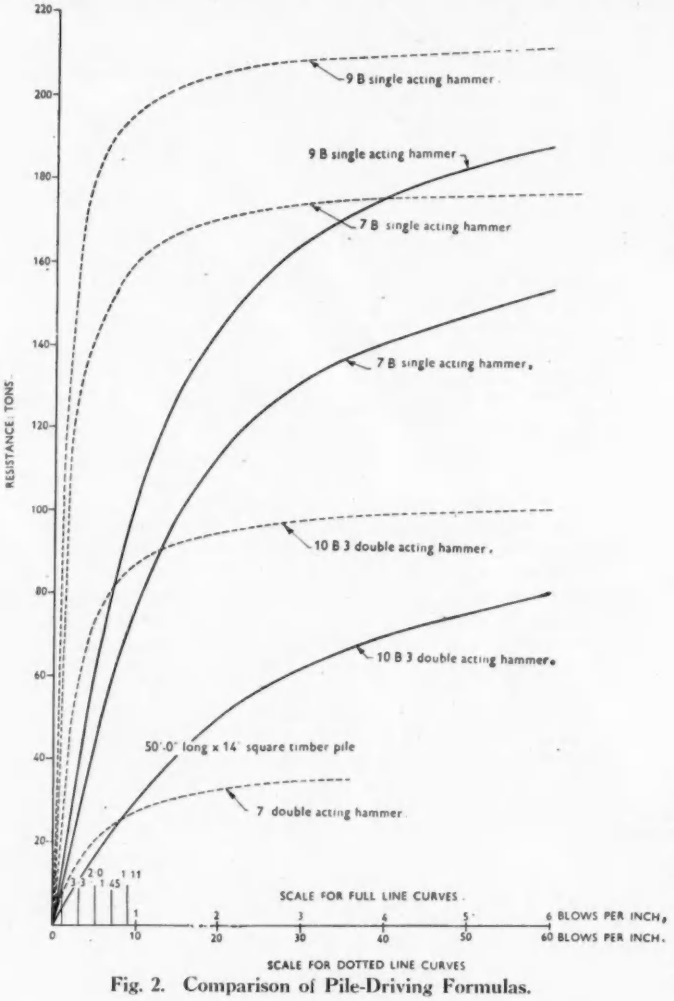


Fig. 2. Comparison of Pile-Driving Formulas.

economy in reinforced concrete. A pair of timber flitches placed on opposite sides of the pile and bolted through were used to effect the splice. This scheme had the added advantage that the flitches materially increased the bearing capacity. A cross-section of the wharf and extension is shown in Fig. 5.

In the case of a wharf recently constructed on piles in a soft foundation, the procedure was reversed. The primary consideration in the design was rapidity of construction owing to war-time requirements, and for this purpose timber was the ideal material, since waling and bracings could be quickly applied and the connections made by bolting. The use of timber, however, had to be severely restricted and it was necessary to use as much reinforced concrete as possible. A composite pile was therefore adopted, this time with the lower part of reinforced concrete and the upper of timber, which could readily be drilled for bolting on the bracings. The splices were made in the yard and the piles were handled complete. This necessitated special precautions in handling, but no serious difficulties arose and the work was successfully carried out. The piles are shown in cross-section in Fig. 9. (*Vide* next issue).

The limit of economical construction in soft ground on piled foundations is probably reached at a working load of 15-20 tons per pile. For lower bearing values an alternative form of support is more suitable. Close spacing of the piles is not always a solution, as the loads from railways and cranes are heavy and concentrated. It is thus necessary to use tight groups of piles, and this introduces practical difficulties. There is, in addition, a limit to the use of a large number of piles since the dead weight of the piles themselves become disproportionately great. In order to overcome this difficulty the screw pile has been developed, although it was designed originally for an entirely different purpose.

Screw Piles

It may be of interest to trace briefly the history of the invention and development of the screw pile, and its evolution into the screwed cylinder used during recent years in wharf construction.

In about 1835 Mr. Alexander Mitchell, M.Inst.C.E., contemplated a project which involved the necessity of obtaining a much greater holding power than was possessed by any pile or mooring

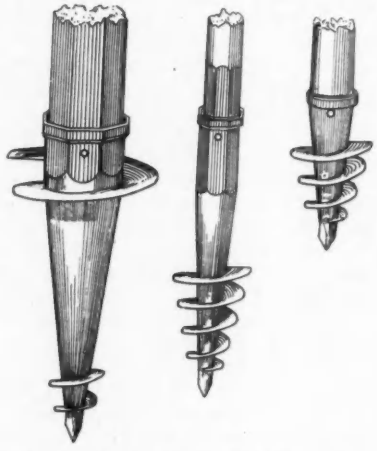


Fig. 3. Early Types of Pile Screws.

then in use. His plan was to insert into the ground, to a considerable depth, a bar of iron having at its extremity a large metal disc in helical form, which might be expected to pass any obstacle encountered during driving without materially disturbing the surrounding ground. At the same time it would provide, when in position, a substantial effective bearing area.

This screw pile was first used for establishing permanent moorings at certain harbours, and proved satisfactory. During a great gale in 1848 a large number of ships on Mitchell's moorings at Newcastle-on-Tyne suffered less than £10 worth of damage. On the other hand, at Sunderland, several ships riding to the old type of block mooring dragged, and up to £30,000 worth of damage was done.

It will be seen that the screw was originally invented in order to resist an upward pull. Its value, however, when used for the puspose of supporting loads in soft ground was quickly appreciated. The screw was first used as a pile in about 1837, when a lighthouse was built on screw piles on the Maplin Sands in the Thames Estuary. Considerable opposition to this new conception in lighthouse construction arose, but it was urged that the greatly reduced area exposed to wave action justified the lighter form of structure.

The Corporation of Trinity House was very sceptical as to the possibility of building a permanent structure on soft ground, its usual practice in such areas being to light the channels with buoys or lightships, but work was eventually commenced on the Maplin Sands lighthouse.

Design of Wharves on Soft Ground—continued

It was decided to screw the piles and then leave them untouched for a period of two years before completing the structure, in order to ascertain whether the action of the sea would cause any change in their position. In the meantime, another lighthouse was constructed at Fleetwood-on-Wyre in Morecambe Bay. This latter was commissioned in June, 1840, and was the first screw pile structure to be completed having its foundations in loose and occasionally shifting sand. The piles were 5-in. in diameter and 16-ft. long with 3-ft. diameter screws and had 12-ft. of penetration into the ground. The lighthouse was carefully watched during the 10 years following the construction, but only required occasional painting.

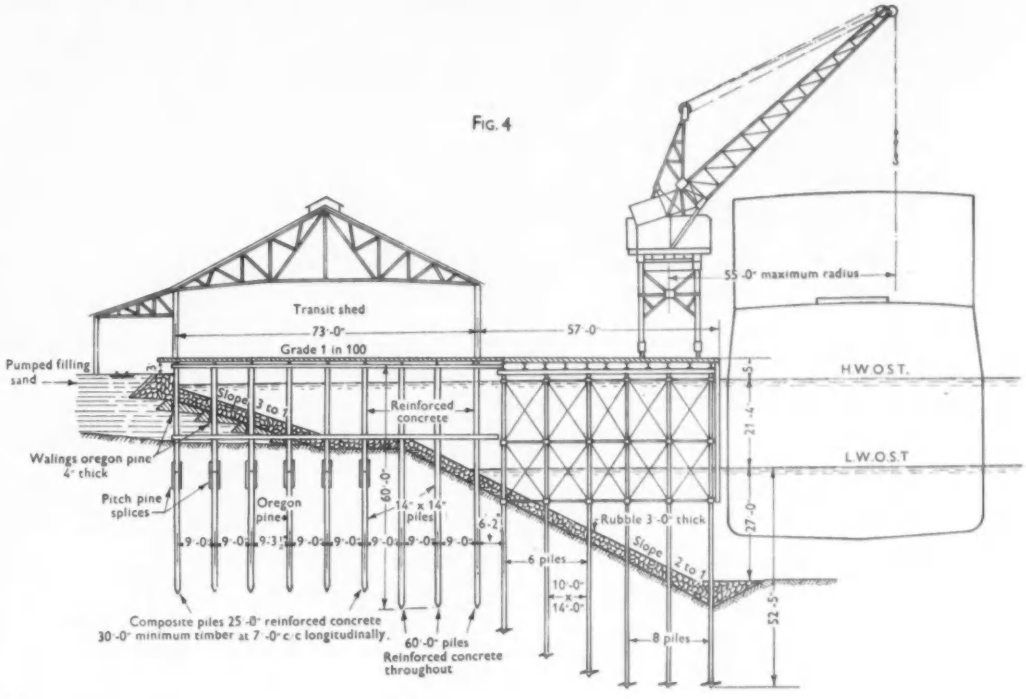
In 1847 a jetty was put in hand at Waterford, Ireland, and owing to the soft nature of the ground screw piles were used for the foundations. The piles were placed in bents 17-ft. apart in a direct line outwards. A projecting stage was built out from the land to a distance of 17-ft. and the first bent of piles was then screwed from it. These were braced together and the stage was pushed out a further 17-ft. to the next bent.

Another early example of screw pile foundations is to be found in a pier constructed at Southampton in 1892. The main piles were of cast-iron pipes 8-in. in external diameter with a 1-in. thickness of metal and an average of 40-ft. The screws were 2-ft. 9-in. diameter, the helical plate making about 1½ revolutions with a 5-in. pitch. These screws were satisfactory and were driven a minimum of 5-ft. into the solid ground below the mud.

A familiar type of structure built on screw piles is the promenade pier to be seen at so many British seaside resorts. Their great advantage is that they present little resistance to seas and even in the heaviest gales there is no appreciable impact. This is a strong argument for the adoption of steel pile construction on an open foreshore. One disadvantage which may be thought to arise is that of liability to corrosion by sea water. This, however, progresses slowly and structures built of cast-iron piles as early as 1847 were still in good condition in 1922. At a harbour pier at Fleetwood where the timber piles had been encased in cast-iron plates in 1840 very little deterioration was observed after 80 years. The piles often seem to be in bad condition, but they are only coated with barnacles and these appear to form an additional protection.

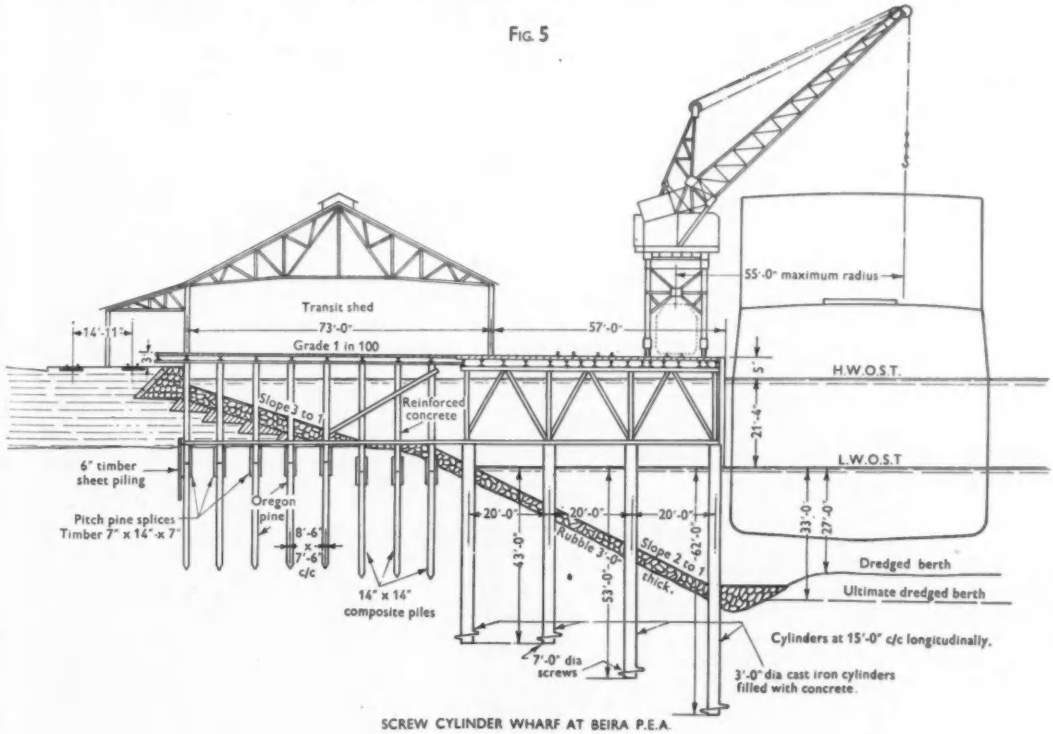
A disadvantage of screw piles is their slender nature as a column. This is met by using below low-water-level further bracing, in such a way that the piles

FIG. 4



SCREW PILE WHARF AT BEIRA P.E.A.

FIG. 5



SCREW CYLINDER WHARF AT BEIRA P.E.A.

Design of Wharves on Soft Ground—continued

are supported evenly along their whole length. While Mitchell was driving some screw piles off the coast of Ireland for a proposed lighthouse a sudden gale stopped work just after the piles had been screwed, and before they could be braced. The seas pulled them about to such an extent that the project was abandoned. At Maplin Sands, however, where the piles were left for two years with the under-water bracing in position no movement was recorded.

All of the works referred to above were constructed on piles having a simple plate in helical form as a screw, which has proved satisfactory in very soft ground. Other designs have been made for different types of ground, ranging from silt to hard boulder clay, for use when the employment of driven piles was undesirable. Mitchell designed three types of screw for quick driving which could be used for supporting sheds, telegraph poles, railway signal posts, and the like, in any type of ground other than rock. A number of different designs for the point of the screw have been used to work in chalk, clay, shingle, and sand, but the most commonly used is the simple conical point. Some early types of screws are shown in Fig. 3.

Columns for screw piles are usually of two types, either a hollow cast-iron barrel with a bolted joint rather similar to a cast-iron pipe with an unusually thick skin, or a solid steel bar. The former type was frequently used for pier construction and has the advantage of the resistance offered by cast-iron to corrosion. In modern structures the solid steel pile bar is frequently used, the diameter being usually 6-in., 7-in. or 8-in. Each length has a pair of parallel flat surfaces formed at both ends for driving, and joints are effected by a muff coupling with one pin to each bar length. The helical screws are usually of cast iron and attached to the pile bar by a single pin which serves only to carry the weight of the screw during pitching, the whole of the torque being transmitted through the flats mentioned above.

The early screw piles were rotated by means of a large wheel 32-in. in diameter, keyed to the pile, and having a grooved rim for a rope drive. The driving rope was tensioned between the driving sheave and a smaller idler situated about 150-ft. away. A gang of men then pulled on the rope and thus screwed the pile into the ground. This method was found unsatisfactory for screwing piles in a hard mass such as rock chalk and a hydraulic screwing machine was devised, consisting of two hydraulic cylinders with rams operating a ratchet wheel bolted to the pile. A disadvantage of this method was the loss of time in the return stroke and the machine was not adopted for general use.

Another method of screwing piles was by means of a large hand-operated capstan of the type used on the old sailing ships. This consisted of a capstan head attached to the pile, into which the bars could be inserted. The pile was then screwed by a crew of men heaving round in the traditional manner. It is believed that screwing has also been carried out by using a capstan drawn by horses.

The modern method of screwing piles is by electric capstan. This consists of a steel frame oval in shape and carrying two electric motors symmetrically disposed about the centre. Each of these drives through a reduction gear to a pinion gearing with a spur wheel, into the boss of which the end of the pile-bar can be inserted. The torque reaction is taken up by means of two guy wires which are, in fact, parts of a single continuous wire passing through fairleads in the capstan frame. One guy anchor is usually placed in the sea or river bed ahead of the work, the other end of the continuous wire being hove down to the deck of the completed wharf behind. After the erection crane has lifted the capstan into position on the pile the continuous guy wire is pulled taut through the capstan and the fairleads tend to ensure an equal pull in each guy. The motors are usually wound for direct current and operated by a controller situated on the deck of the wharf. The readings of the ammeters are watched carefully, as they give a measure of the torque and thus an indication of the hardness of the stratum through which the screw is passing.

A number of interesting developments in screw-piled wharves for heavy traffic have occurred during the present century, notably that at Garden Reach, Calcutta, and at the Port of Beira. This latter wharf (Fig. 1) was described in 1935 by Mr. T. C. Frampton, Assoc.M.Inst.C.E.[1]. In this case the principal piles used had solid steel shanks 8-in. diameter with 5-ft. diameter screws, and others of 6-in. diameter with 5-ft. screws. The depth to which these piles were sunk gave a minimum penetration of 26-ft. into the ground. The maximum loading of the piles was calculated at 26 tons, which gave a unit load of 1.33 ton per square foot on the ground.

Representative piles were tested with a load of 33 tons, that is, 25 per cent. in excess of the maximum load which they would be called upon to carry, and the permanent settlement of the 8-in. piles was found to be only from 1/16-in. to $\frac{1}{8}$-in. One pile settled $\frac{1}{4}$-in. under the application of the load and recovered entirely when the weight was removed. The 6-in. diameter piles were tested under an equal load and the settlement ranged from 1/16-in. to 3/16-in. Here again one of the piles tested showed no permanent settlement. This wharf has been in use for 15 years and has proved entirely successful.

The great objection to screw-piled wharves where the depth of water is considerable has already been mentiond, namely, the necessity for under-water bracing. This bracing is costly to fix in the first instance, and also to maintain. When extensions of the wharves at Beira were required, Mr. (now Sir) W. T. Halcrow, M.Inst.C.E., decided to depart from the screw-pile design and investigate the possibility of using screw cylinders, hitherto used only for bridge piers and building foundations. He therefore had a test cylinder sunk at Beira and, when satisfied with the results obtained from the tests made, put in hand 2,000-ft. of deep-water wharf to the cross-section shown in Fig. 5.

Three tests were made with a 3-ft. diameter cylinder having a 7-ft. diameter screw. The cylinder in the third test was sealed with concrete and in all three cases the load was left on for 48 hours. The following table shows the results obtained:—

Test.	Depth Screwed: feet	Load on Screw.		Settlement		Recovery. inches
		Total tons.	Tons per square foot	Maximum: inches.	Permanent: inches	
1	44	156	4·45	2	1½	½
2	61	160	4·57	1½	1	½
3	61	160	4·15	⅞	½	⅜

(*To be continued*)

[1] "The Development and Construction of the Port of Beira," Min.Proc.Inst.C.E., vol. 139 (1934-35, Part I), p. 578.

Publications

Belgian Handbook is a handy little booklet issued by the Belgian Information Office, which contains in compact compass a quantity of information on the subjects of Belgian territory, constitution, currency, industries, transport, foreign trade, shipping and ports, agriculture, banking and finance, social services, education and scientific research, besides numerous other matters. The leading ports are, of course, Antwerp (one of the greatest in the world) and Ghent, both of which are situated some distance inland. At Antwerp there are 26½ miles of dock frontage and 3½ miles of riverside quays. At Ghent, the quays, banks and wharves extend for over ten miles. Included in the volume are political and industrial maps together with a photograph of His Majesty King Leopold III. It is a convenient reference book for all who are interested in the affairs of the country, and has been compiled with the object of "helping a little towards a widespread common understanding" between Englishmen and Belgians, and "so towards perpetuating the mutually helpful intercourse of a thousand years."

The Transactions of the Institution of Civil Engineers of Ireland for the Session 1943-44, contains in addition to the Presidential Address of Mr. T. C. Courtney, a number of papers of great technical intrest, together with the Council's Report and an account of the Annual General Meeting. The Papers do not touch upon subjects germane to the purview of this Journal, so that detailed notice of them must be considered as lying outside the interests of our readers.

Cargo Pilferage at Melbourne

Policy pursued by Melbourne Harbour Trust

The chairman of the Melbourne Harbour Trust (Mr. A. D. Mackenzie) has recently reported an improvement in the position at the Victorian port as regards cargo pilferage, which, at one time, threatened to become a serious menace.

According to a report in the Melbourne *Herald*, Mr. Mackenzie said that the port was the only one in Australia with its own complete and specially trained police force, and because the dock force was part of the State police organisation the men were able to follow up their inquiries anywhere outside the area controlled by the Trust. Since the force was organised 25 years ago, when pillage was as high as 2.4d. a ton of all pillageable cargo landed, the good work of the police force had reduced this to .14d. a ton a few years before the war. Further protective measures were then taken, of which one of the most effective was the " compounding " of berths. A system of issuing cargo checks by shipping clerks from ship to consignee at the dock gates was introduced. At the gate the goods were checked with the cargo check by a policeman and a Customs official.

With the war, pillaging increased again, and in 1942 reached 6½d. a ton for overseas and 2.6d. for interstate cargo. Blackouts, the landing of goods in dark corners and congested areas, the packing of goods in cardboard instead of wooden covers, the extra inducement to steal rationed goods and the subsequent prevalence of black marketing were in turn responsible. Melbourne was also unique in having a " wet " shed where all spiritous liquors were stored away from temptation.

All these safeguards, Mr. Mackenzie added, had reduced the incidence of losses on interstate cargo by pillaging to 1.6d. a ton in 1943—the oversea figures were not available—and it was hoped that it would still be further reduced by the expenditure of £4,500 to " compound " all berths completely and the erection of other security fencing.

Theory of Wave Pressures against Vertical Walls

(Concluded from page 130)

the problem is the only simple one. In the attached figure the only two quantities required to be computed are

$$a = wh \Big/ \cosh\left(\frac{6.2_8\, H}{l}\right)$$

$$h_0 = \frac{3.14h^2}{l} \Big/ \coth\left(\frac{6.2_8\, H}{l}\right)*$$

where w is the weight of 1 cubic foot of water ($\frac{1}{35}$ ton for sea water).

H is the depth of the water from still level to sea bed.

The line AC is actually slightly concave, so that the theoretical pressure is slightly less than that given by the straight line.

C The duration of the Impulse.

The thrust, or moment, computed from the above diagram only acts with full effect at the instant when the water rises highest against the wall and each varies in time in practically the same manner as the rise of the water above the still water level. There is a negative effect when the water is below the still water level but this is not often of practical significance. Speaking roughly, the mean effect acts for about half the periodic time or the *maximum effect* may be presumed to act for about *one quarter* the periodic time. This enables the impulse (force × time) to be computed, from which the mechanical effects (strain-energy in the wall; momentum imparted, etc.), may be approximated to. Usually of course, statical equilibrium against sliding and overturning is the paramount issue.

*Tables of cosh θ and coth θ, the " hyperbolic " cosines and cotangents are given in many handbooks, coth $\theta = 1/\tanh \theta$.

Board Room of the Tyne Improvement Commission

(Concluded from page 122)

slate blue, the shade diminishing towards the picture rail. The frieze is decorated with wall paintings in panels depicting outstanding events in the history of the Tyne; the pillars dividing each panel bear a Coat of Arms of the Commissioners and the various Municipal Corporations on Tyneside.

The ceiling is panelled in plaster and decorated in grey, ivory and gold. The room is lighted by three high-arched double-cased windows, the outer being leaded with tinted panes. Around the walls hang portraits in oils of various Chairmen of the Commission by well-known artists. The two that can be seen in this photograph are the present Chairman (Sir Arthur M. Sutherland, Bt., K.B.E.) and the ex-Chairman (Mr. Harry P. Everett).

The furnishings are in oak with blue hide upholstery. The door seen in the photograph leads to the Chairman's room.

The Head Offices

The Head Offices of the Commissioners, which were built for them and opened in 1886, have since had two more storeys added to the original building which were completed just prior to the outbreak of the first European War in 1914. The photograph here reproduced shews the completed building with its basement, ground and five upper floors. It is in close proximity to the Central Railway Station and the business centre of the City.

Fishery Port of Vigo—continued

(Concluded from page 129)

In view of its nature as an undertaking of public utility, the return that may be anticipated from the money invested in the construction and equipment, is amply adequate to justify the outlay involved, but not only is this so but also the investment is specially remunerative when regard is had to the traditions and the manifest prosperity of the fishing industry as carried on in the Port of Vigo.

The revenue accruing from the fishery port exceeds, at this present time, one million pesetas and in the equipment undertakings there have been invested more than two million pesetas representing a separate contribution from the exchequer of the Harbour Board.

Once the exploitation of all the docks has been firmly launched, the revenue to be expected may, without unwarranted optimism, be calculated as follows:—

	Pesetas
1 per cent. on the value of the fish	1,200,000
Rentals (Departments of Packing, Salt Storage, etc.).	400,000
Refrigerators	60,000
Other concessions	100,000
Rental from 60,000 square metres of ground leased to various industries	300,000
From occupiers of the quay area	50,000
Sundry revenues	40,000

Thus, even on the assumption that the expenses of upkeep and working should rise as high as 400,000 pesetas, there will still remain a rate of interest on the entire investment, of over 3 per cent.

Llanelly Harbour Trust.

At the annual meeting of the Llanelly Harbour Trust, Mr. Edgar G. Rees was elected chairman for the ensuing year and Mr. Owen Jones, vice-chairman.

Sunderland Harbour Appointment.

Captain A. P. Raine, temporary harbour master at the Port of Sunderland, has been appointed by the River Wear Commissioners to be deputy superintendent harbour and dockmaster, in succession to Captain Cooke, who has been appointed harbour master at Dover.